PB 194411

FINAL REPORT

on

TECHNICAL, INTELLIGENCE, AND PROJECT INFORMATION SYSTEM FOR THE ENVIRONMENTAL HEALTH SERVICE
VOLUME II. EHS INFORMATION NETWORK ANALYSIS

to

U. S. DEPARTMENT OF HEALTH,
EDUCATION, AND WELFARE
ENVIRONMENTAL HEALTH SERVICE

June 29, 1970

Contract No. CPS-69-005

by

Ralph L. Darby, Robert S. Kohn, Thomas E. Carroll,
W. David Penniman, and David L. Morrison

BATTELLE MEMORIAL INSTITUTE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

FOREWORD

This report is one of five volumes that were prepared for the Environmental Health Service under Contract Number CPS-69-005. The objectives of this project were to examine research and development program planning needs within the EHS and to develop a management-assistance system for the EHS. Since a well-organized and readily accessible information base is essential to the planning, existing information capabilities and facilities within EHS were surveyed and an environmental health information network was devised. Two model case studies for the environmental stressors, lead and persistent pesticides, were performed, to serve as examples during the project and to exercise the elements of the management assistance system.

The reports in this series are:

Volume I.	EHS Management Assistance and Planning
Volume II.	EHS Information Network Analysis
Volume III.	Lead Model Case Study
Volume IV.	Pesticides Model Case Study
Volume V.	Directory of EHS Information Facilities With Selected Supplementary Resources

MANAGEMENT SUMMARY

Summary. The Battelle study entitled "Technical, Intelligence, and Project Information System for Environmental Health Service" is a multifaceted and intensive investigation of the problems facing the EHS in protecting man's environment from threats created by man. This study included the following major efforts: (1) research and development planning in the perspective of man in his total environment, (2) information network analysis, and (3) model case studies. This section of the report concerns itself with Information Network Analysis. The first step was to investigate the existing EHS information resources, including the monitoring and surveillance activities. A survey was conducted of the documentation systems and libraries in order to determine their operational characteristics as related to an information network.

The results of this survey, including a limited number of external information resources, are contained in a separate volume entitled "Directory of Information Sources for the Environmental Health Service".

Additional data were obtained through limited personal and telephone interviews at all levels of EHS and its Administrations and through study of EHS documentation.

On the basis of the study, the establishment of an Environmental Health Information Network (EHIN) has been structured, incorporating the existing information and data sources, and also new resources such as the Information Resource Identification System (IRIS) and the Project Information Retrieval System (PIRS).

In structuring the proposed EHIN, it is recognized that other agencies of the Federal Government have established information and data bases that relate to EHS responsibilities. Mechanisms for interfacing and utilizing these resources are suggested. Further, it is recognized that an operational EHIN, structured as a result of this study, may not be immediately achievable. Rather, EHIN represents a concept which EHS should build toward as it is able in order to assist in constantly strengthening its role in protecting man's environment.

Specific conclusions and recommendations are detailed in the following section of this Management Summary. The reader is urged to study the more detailed discussions in the body of the report.

Conclusions and Recommendations. The following recommendations are made for the establishment of an Environmental Health Information Network (EHIN):

(a) The network should be a coordinated network* consisting of a Project Information Retrieval System (PIRS), a Monitoring, Surveillance, and Intelligence Information System (MSIIS), and a Scientific and Technical Information System (STIS), supplemented by an Information Resources Identification System (IRIS).

(1) PIRS should be a centralized system, operating within EHS. The early establishment of PIRS is urged.

---

*Described on page 31.

(2) IRIS should be a relatively small operation, maintaining an inventory of information resources and providing switching and referral service* both for the use of the entire staff and for referral of other agencies desiring information to the proper portion of the EHIN network. Implementation of IRIS should begin as soon as practicable.

(3) MSIIS and STIS should each remain a federation of centers in a coordinated network structure. Each center or activity should report to the highest authority consistent with its mission, scope, and user audience.

(b) Within the EHS headquarters element, a Director of EHIN should be appointed to represent and to coordinate the interests of the network, not only at the EHS level, but also in interagency and other Federal activities.

(c) The Director of EHIN should be assisted by an Advisory Council composed of the coordinating managers of PIRS, MSIIS, and STIS plus five representatives from the operating levels. The Advisory Council would assure the vitality of the network, determine network requirements for equipment, and recommend establishment, consolidation, or disestablishment of activities within the network.

(d) Very little analytical response (e.g., state-of-the-art reports, technical compilations, data or design handbooks, and direct answers to technical inquiry) can be expected from the present information resources, both within EHS and outside EHS. EHS should establish Centers of Technical Competence (Information Analysis Centers) for various high-priority threat areas in order to provide the needed analytical capability.

(e) Necessary information resources and capabilities for effective analysis and evaluation of threats are so great in magnitude and variety that they cannot be concentrated within any single agency. To cope effectively with the complexities of today's environmental problems, a wide variety of information resources should be utilized.

(f) There is a lack of accurate, documented information relative to the identification of sensitive population groups, to the determination of the number of people currently and potentially affected by a stressor, and to the nature and severity of the effect. This represents an information gap which should be filled on a selective basis.

(g) Accepted thesaurus building rules should be enforced in all EHS information activities in order to establish some compatibility of the various thesauri in terms of cross-reference techniques and similar devices. Growth of special-purpose information systems however should not be stifled by the creation of a unified vocabulary.

---

*Switching and referral are defined on page 84.

(h) Whenever practicable, without harm to the direct mission of a given information resource, common information science procedures and practices should be instituted.

(i) The "Directory of Information Sources for the Environmental Health Service" (prepared during this study) should be revised periodically by IRIS to provide a desktop reference device for operating-level personnel.

(j) Various facilities probably can justify, and should have, a stand-alone computer capability in addition to access to the central computer facility, primarily for data-processing and research purposes. However, with regard to information systems, every effort should be made to strive for compatibility of operations.

(k) The computer facility provided for EHS administrative operations, including information storage and retrieval operations, should equal or exceed the capability of the equipment currently employed by the central computer facility, if that facility cannot be made available to EHS.

(l) The Director of EHIN and his Advisory Council should investigate the extent to which information resources dealing with program assistance, training, and demonstration and testing should be established and incorporated into the network.

TABLE OF CONTENTS

Page

MANAGEMENT SUMMARY

INTRODUCTION 1

SURVEY OF EXISTING INFORMATION RESOURCES OF THE EHS 4

Analysis of Existing Systems 4
Previous Surveys of EHS Information Activities 5
Current Survey of Information Resources and Their Characteristics 7
Coordination Versus Centralization 17
Information Resources Versus Planning, Programming, and Budgeting System Functions 19
Conclusions Based Upon Survey of EHS Information Facilities 23

INFORMATION SUPPORT TO THE MODEL CASE STUDIES 25

Purpose of the Model Case Studies 25
Stressors 25
Information Requirements 26
Lead Stressor 26
Pesticide Stressor 26
Identification and Acquisition of Information and Data 27
Evaluation of Information Response 32
Responses From the Information Sources 32
Gaps in System Coverage 32

MONITORING AND SURVEILLANCE NETWORK 34

Background 34
Inventory of Existing Monitoring and Surveillance Activities 35
Past CPEHS Efforts 35
Other Inventories of Monitoring and Surveillance Activities 36
Current Inventory of EHS Activities 36
National Data Banks 40
SAROAD 41
Other EHS Data Bank Activities 42
Water Quality Data Storage and Retrieval System 42
The Concept of a Monitoring, Surveillance, and Intelligence Information System (MSIIS) 42
Inventory, Switching, and Referral Capability 44
Interface With the Scientific and Technical Community 45
Alerting Function 45

PROJECT INFORMATION RETRIEVAL SYSTEM (PIRS) 46

Current Status of Management Systems 46
Administration-Level Systems 46

TABLE OF CONTENTS
(Continued)

Page

EHS-Level Developments 47
Outside Sources 51
PIRS Versus Administration/Bureau Systems 51
Design Parameters of PIRS 52
Mission 52
Response Time 52
Content 52
Structure of PIRS Data Base 55
Internal System Characteristics of PIRS 58

CENTERS OF TECHNICAL COMPETENCE 58

Introduction 58
The Role of CTC's in Support of EHS 59
Guidelines for Centers of Technical Competence 60
Organization and Operation 63
The Advisory Council 63
The Panel of Scientists and Technologists 65
CTC Coordination 65
Conclusions 65

SERVICE-WIDE THESAURUS 65

Air Pollution Technical Information Center (APTIC) 66
Thesaurus 66
Microthesaurus 67
Radioactive Materials Thesaurus 67
X-Ray Thesaurus 67
Office of Compliance and Standards 69
Data Systems and Mathematics Section 69
Solid Waste Information Retrieval System (SWIRS) 69
Comparison of Vocabulary Control Techniques Used Within EHS 69
Vocabulary Control Conclusions and Recommendations 69

COMPUTER STATUS 73

General 73
Central Facility 74
Administration Facilities 74
NAPCA ADP Task Force Summary 76
ECA ADP Task Force Survey 77
Conclusions and Recommendations for EHS Computer Facilities 79

THE CONCEPT OF INFORMATION NETWORKS 80

THE ENVIRONMENTAL HEALTH INFORMATION NETWORK (EHIN) 85

TABLE OF CONTENTS
(Continued)

Page

Theoretical Versus Realistic Network 85
  Formal Organization 85
  Rapid Communications Capability 85
  Bidirectional Operations 85
  Directory and Switching Capability 86
Network Components 86
Organization 86
  Director of EHIN 88
  EHIN Advisory Council 88
  Information Resource Identification System (IRIS) 88
  Project Information Retrieval System (PIRS) 89
  Monitoring, Surveillance, and Intelligence Information System (MSIIS) and Scientific and Technical Information System (STIS) . . 89
  The Role of EHIN 89
  EHIN as a Threat Evaluation Tool 91

IMPLEMENTATION OF EHIN 95

REFERENCES 97

APPENDIX A

SURVEY QUESTIONNAIRE FOR CATALOG OF INFORMATION FACILITY CHARACTERISTICS FOR A CONSUMER PROTECTION AND ENVIRONMENTAL HEALTH INFORMATION NETWORK A-1

APPENDIX B

LIST OF INFORMATION SOURCES FOR USE IN THE LEAD AND PESTICIDE MODEL CASE STUDIES B-1

APPENDIX C

LIST OF JOURNALS AND TEXTBOOKS FOR USE IN THE LEAD AND PESTICIDE MODEL CASE STUDIES C-1

APPENDIX D

INFORMATION ANALYSIS CENTERS D-1

APPENDIX E

THESAURUS RULES AND CONVENTIONS E-1

LIST OF FIGURES

Page

Figure 1. Rationale for Survey in Creation of Network Structure 9

Figure 2. Information Flow During Model Case Studies 28

Figure 3. Sample KWOC Index of Research Projects Arranged by Assigned Project Number 49

Figure 4. Sample KWOC Index of Research Projects Arranged by Project Titles 50

Figure 5. Information and Data Sources for PIRS Arranged by Rank Order of Importance and Attainability 56

Figure 6. The Supportive Role of the Centers of Technical Competence . . . 61

Figure 7. Generalized Organization Chart for Center of Technical Competence 64

Figure 8. APTIC Microthesaurus – Sample Page 68

Figure 9. Representative Listing From Central Facility Directory of Automated Jobs 75

Figure 10. ECA Computer Workload Adjusted to an IBM 360/30 78

Figure 11. Network Organizations 83

Figure 12. General Conceptualization of Environmental Health Information Network 87

Figure 13. Role of the Environmental Health Information Network 90

Figure 14. The Environmental Health Information Network shown in the Agglomerated, Coordinated, Configuration 92

Figure 15. Possible Role of EHIN During Threat Evaluation 93

LIST OF TABLES

Table 1. Selected Recommendations from Survey of Technical Information Systems in the Consumer Protection and Environmental Health Service 6

Table 2. Examples of Design Parameters Related to Information System Characteristics 10

Table 3. Relation of Questionnaire to General Information Network Characteristics 11

LIST OF TABLES
(Continued)

Page

Table 4. Survey Population of EHS Information Facilities 13

Table 5. Comparison of Coverage of Battelle Survey With Previous Surveys . 15

Table 6. Summary Table of Total EHS Information and Data Sources 18

Table 7. The Nine PPBS Functions 20

Table 8. Functional Categorization of Information Resources by PPBS Category 21

Table 9. EHS Source Contacted for Information for Lead Model Case Study. . 29

Table 10. Non-EHS Sources Contacted for Information for Lead and Pesticide Model Case Studies 30

Table 11. EHS Monitoring and Surveillance Facilities 37

Table 12. Data Banks Planned or Operating Within EHS 43

Table 13. Mission Statement for MSIIS 44

Table 14. Required Information Elements 48

Table 15. Mission Statement for PIRS 53

Table 16. Sample PIRS Inquiry Scenarios 54

Table 17. List of Key Term Categories for Office of Compliance and Standards Retrieval System 70

Table 18. Sample of Classification Used by Data Systems and Mathematics Section, Bureau of Radiological Health 71

Table 19. Comparative Analysis of EHS Vocabulary Control Techniques . . . 72

Table 20. Tabulation of Computer Facilities Serving EHS Operations 74

Table 21. Current Computer Usage by NAPCA Converted for Various Replacement Computers 76

Table 22. Identification of Information Networks 82

Table 23. General Characteristics of Information Networks 82

BLANK PAGE

TECHNICAL, INTELLIGENCE, AND PROJECT INFORMATION SYSTEM FOR THE ENVIRONMENTAL HEALTH SERVICE
VOLUME II. EHS INFORMATION NETWORK ANALYSIS

by

Ralph L. Darby, Robert S. Kohn, Thomas E. Carroll,
W. David Penniman, and David L. Morrison

INTRODUCTION

In considering information requirements within the Environmental Health Service (EHS), one must consider the role EHS is to play both within the Federal Government and within American society as a whole. EHS must be able to speak with authority and knowledge for the Department of Health, Education, and Welfare if it is to be the focal point of environmental health of the American population. This, after all, was the intent of the Secretary of Health, Education, and Welfare in his order of July 1, 1968, which established the forerunner of EHS, the Consumer Protection and Environmental Health Service:

> "The Service provides leadership and direction to programs and activities designed to assure effective protection for every American against hazards to health in his environment and in the products and services which enter his life".(1)

The terms "leadership and direction" in themselves imply that EHS must have command of a vast array of knowledge and information in order to know what the state of the environment is, what insults may threaten the healthful state of man's environment, and what can be done to protect it. Further, the terms "programs and activities" within themselves imply that the EHS must have full knowledge of not only research programs in environmental control, but also the activities of man which may constitute an insult to the environment.

The whole area of environmental health is recognized as being extremely complex and volatile. The role of EHS in relation to the many councils, advisory boards, and so forth currently being created remains yet to be clarified. A few such groups worthy of noting are(2):

- The Environment and Natural Resources Study Group of the President's Advisory Council on Executive Organization
- Council on Environmental Quality (P. L. 91-190)
- Environmental Quality Council (Executive Order 11472)
- Citizen's Advisory Committee on Environmental Quality
- President's Task Force on Air Pollution.

Congress has established a number of committees including:

- House Government Operations Subcommittee on Conservation and Natural Resources
- Senate Commerce Committee on Conservation and Natural Resources
- Senate Public Works Subcommittee on Air and Water Pollution.

Combined with these activities, the division of responsibility in the area of environmental-quality control must also be considered.

- Interior: Federal Water Pollution Control Administration
- Transportation
- Agriculture
- State
- Commerce: Environmental Science Services Administration (ESSA)
- Defense: Defense Environmental Control Committee, Natural Resources Directorate.

The importance of environmental health was further emphasized by the Presidential message to Congress of February 10, 1970, which identified environmental health as a major "national target" for the 1970's.

The Environmental Health Service, in examining its role of protecting man in his environment, early recognized the necessity for "good" information and data at all levels of the Service. The management function itself required adequate information to permit it to interface with the Congress, to provide for planning, programming, and budgeting, to provide a mechanism for rating threats to man's environment, and to permit decisions as to the best moves to meet or correct the threats to the environment.

At the same time, the several Administrations (Environmental Control Administration, National Air Pollution Control Administration, and Food and Drug Administration*) also required adequate information to plan, to administer their programs, to move to meet the threats to the environment, and to monitor the environment, not only to control existing threats, but also to detect new insults as quickly as possible.

The multidisciplinary nature of man's environment and the multiplicity of threats to man's well being within this environment create a complicated information problem. The identification, in some meaningful way, of the breadth and scope of scientific and technological information required to both analyze a potential threat and seek means to counter or correct the situation, is itself a complex and difficult problem.

Various elements within both NAPCA and ECA (as it was constituted at the time of this study) have established libraries and documentation centers to meet their specific needs. Because of the unity of interests within NAPCA, e.g., air pollution, it has been possible to establish a single information center, the Air Pollution Technical Information Center (APTIC), to service the entire administration.

---

*At the time this project was begun, the Food and Drug Administration was part of the Consumer Protection and Environmental Health Service (CPEHS). Separation of FDA from CPEHS and the formation of EHS was announced on December 11, 1969.

ECA, because of its broad diversification of interests, found itself faced with a much different problem. There was no common denominator which formed a focus for a single specialized center. As a consequence, several separate and quite distinct libraries, reading rooms, and information resources were established to meet the diverse needs within the Administration.

Throughout the operating levels of EHS, a number of activities have been established which collect data and information to meet some specific requirement levied upon a particular Bureau or Office. Examples of these facilities are the Fuel Additives Register, the Federal Facilities Air Pollution Inventory Program, Neighborhood Environmental Evaluation and Decision System, etc. While such activities themselves performed useful functions, it was not known to what extent they could provide useful information/data to higher administration levels and to the scientific and technical community. Duplication, per se, was probably of no real concern, but the possibility of obtaining a synergistic effect by combining and extending the data capacity of some activities was indeed valid.

Beyond these are the monitoring and surveillance networks. Data from these networks should be of real value in management decision making and in providing responses to legislative query by establishing proper analyzing and reporting procedures to higher echelons of EHS.

In conjunction with its Information Consultant, EHS was currently developing a service-wide project information system. The system was intended to assist the scientist in obtaining information about EHS-supported efforts related to his work, to provide a rapid exchange capability for technical and management data, and to provide data on EHS activities to interagency data collection or coordination groups.

The question, then, was one of developing a network that would encompass these many resources in a synergistic manner to benefit and to assist all levels of activity within EHS.

After studying available material related to EHS information resources, including two earlier surveys, the project team decided it would be desirable to resurvey the existing information facilities. This step was necessary to assure that the data required for the network analysis was current and consistent. Emphasis in the survey was placed upon relating information-system characteristics to information-network concepts. The eventual goal was to meet the total user requirements within the EHS user community.

The roles of the monitoring and surveillance system and the developing project information system in supplying information/data to management and to the scientific community, and those of the stressor matrix, were included within the overall study in order to assure full utilization of all resources within the EHS community.

On the basis of model case studies of lead and pesticides in the environment, the information and data requirements of two scientific teams were explored in order to relate their needs to the EHS information resources.

From the information foundation established by all these avenues of approach, recommendations for the structuring of an EHS information network were developed. In structuring the network, emphasis was placed upon the early development of a pragmatic system designed to meet user requirements at all levels of the EHS organization. While the state of the art has advanced to a level where more exotic, monolithic information systems could be considered, the project team elected to tailor the network more closely to the working needs of the EHS community.

This portion of the overall project report, dealing with the EHS information network, reviews the investigation of information resources pertinent to the interests of the EHS Headquarters Element, the National Air Pollution Control Administration (NAPCA), and the Environmental Control Administration (ECA) as constituted at the time of this study. On the basis of this review, recommendations are made for the establishment and structure of an Environmental Health Information Network (EHIN).

SURVEY OF EXISTING INFORMATION RESOURCES OF EHS

Throughout the Environmental Health Service, there exist many individual and very specific requirements for information and data necessary to accomplish the announced Service objective. These requirements vary from high-level-management information needs for Planning, Programming, and Budgeting Systems (PPBS) activities to project level scientific- and technical-information data.

The constituent parts of the Environmental Health Service recognized, even prior to the creation of the EHS, a need to provide their staffs with information support at all working levels. This is evidenced by the many diverse information resources residing in the present EHS structure.

The first task, therefore, was to identify the existing information resources of EHS and the characteristics of these resources as they related both to their direct user audience and the total EHS information and data network.

Analysis of Existing Systems

Four categories of information needed to be considered with respect to EHS requirements and the existing sources of information/data already operational within the Service. These were:

(a) Management Information (PPBS)

(b) Scientific and Technical Information

(c) Specialized Centers for Compliance and Control

(d) Monitoring and Surveillance.

Each of the four categories of information listed above is distinct in nature, but all play equally important roles as sources of information and intelligence related to environmental conditions. The problem was that of inventorying these resources to determine the nature, capabilities, and operational characteristics of each.

Ideally, it was desirable that the research team visit all operations to discuss in depth the nature and requirements for each. Time and funds made this impracticable. Therefore, a variety of methods were used including

(a) Review of existing EHS, FDA, ECA, and NAPCA reports

(b) Use of a survey questionnaire

(c) On-site visits to principal centers

(d) Referral to the annual planning reports of ECA and NAPCA and the Office of the Administrator

(e) Additional data obtained by telephone

(f) Directories and services identifying sources external to EHS.

Previous Surveys of EHS Information Activities

Excellent progress has been made by CPEHS in surveying the information resources within the FDA, ECA, and NAPCA. While these surveys were of only transitory value to the investigating team, it is desirable to review them briefly.

Survey by Division of Management Systems - CPEHS. This 1968 survey(3), commonly referred to as the "Hause Report", covers not only information activities internal to CPEHS but also other Public Health Service and Federal information activities related to the scope and mission of CPEHS. The general conclusion on the status of information activities within CPEHS at the time of the 1968 survey is best summed up in the following statement quoted from the report:

> "In each Administration's technical information activities, the difference between needs and their fulfillment, the distance between plans and performance and the gap between promise and reality is a profound one. The status of information systems, systems coordination and systems services is a sorry one."

Specific conclusions and recommendations are then drawn, including proposed actions at the administration and service level. These recommendations, summarized in Table 1, were based on the need for coordination, communication, organization, and evaluation of technical information efforts. While these represent only a portion of the total number of recommendations included in the "Hause Report", they are considered of particular significance to the present study.

OST Review of CPEHS Information Programs(4). The Committee on Scientific and Technical Information (COSATI), acting for the President's Office of Science and

TABLE 1. SELECTED RECOMMENDATIONS FROM SURVEY OF TECHNICAL INFORMATION SYSTEMS IN THE CONSUMER PROTECTION AND ENVIRONMENTAL HEALTH SERVICE

Administration Level (designate a coordinator who will)

- Determine information needs and develop programs to meet them
- Identify, describe, and set goals for existing and planned information system
- Monitor progress of systems in achieving their goals
- Review and evaluate existing and planned systems
- Study information needs and existing and needed resources
- Train, develop, and retain competent personnel in system analysis, design, programming, and operation of information systems
- Establish and chair a Technical Information Committee to help achieve these recommendations

Service Level (science information coordinator should)

- Furnish leadership and guidance to administration-level groups performing systems planning
- Develop and maintain a plan, schedule, and reporting system for information activities throughout the service
- Monitor and assist development of information systems
- Encourage use of cost/benefit and other objective analysis techniques in information activities
- Assure optimum organization of information activities within service
- Establish and chair a Technical Information Committee composed of Technical Information Coordinator from each Administration and representatives from the Office of the Assistant Administrator for Administration

---

Source: "Survey of Technical Information Systems in the Consumer Protection and Environmental Health Service", prepared by the Division of Management Systems, Assistant Administrator for Administration, CPEHS, PHS, DHEW, November, 1968, pp 38 and 39.

Technology, periodically reviews information systems within Federal agencies. In March, 1969, a review of CPEHS information activities was held in the Executive Office Building, Washington, D. C. Each administration, in addition to the oral briefing, compiled descriptive material on various information activities within its respective administration. The three compilations (FDA, ECA, NAPCA) were useful to the Battelle team in planning its survey of facility characteristics. The following paragraphs describe in more detail the contents of these reviews.

The survey of ECA information activities included in the OST review consisted of a description and evaluation of the identified activities within each Bureau. The general conclusion of this survey is summed up in the following paragraph from the OST report(4):

> "Although we are organizationally peer to these two (FDA, NAPCA), informationally we are not their equal. Our sister groups came into CEPHS as already established organizations. Incidentally, each brought with it a developed, operating technical information element, including staffs, technical information systems of varying sophistication, standard and unique literature collections, and well defined programs. On the other hand, ECA, a newly formed agency, composed of an amalgam of groups from various sources, originated without any centralized technical information capability. The substantive components which were joined to form ECA have technical information support of differing qualities, finesse, sophistication, and development. Yet, it must be reiterated - there is no formal centralized technical information structure within ECA."

The OST review of NAPCA activities centered on the functions of the Office of Technical Information and Publications (OTIP), particularly the operations of the Air Pollution Technical Information Center (APTIC). Brief descriptive material was also included on the Technical Audio-Visual Material Section, the Technical Publications Section, and the Technical Information Methods Section.

A similar review of FDA information activities, primarily the Science Information Facility (SIF), was also conducted. The subsequent removal of FDA from CPEHS and the reformation of CPEHS into EHS required that the FDA information activities be treated as external information sources.

Current Survey of Information Resources and Their Characteristics

A review of the previous surveys revealed that information regarding systems characteristics, desired for network considerations, was either lacking or reported inconsistently. Further, owing to the rapidly expanding areas of responsibility within EHS, some of the dates in previous surveys were out of date.

Through consultation with the EHS Project Monitor, it was determined that the best means of resurveying the facilities was by using a questionnaire distributed through the Commissioners of FDA, ECA, and NAPCA.

It was necessary to design a questionnaire which would provide information not only on the scope and size of the various facilities but also on their operating characteristics related to network design.

Design of Survey Questionnaire. The design of the survey questionnaire required that consideration be given to the general characteristics of information networks. While details of such networks are discussed in greater depth elsewhere in this report, it is important to consider briefly some network characteristics at this point in the study.

The network characteristics have been described in the literature(5) as follows:

- Formal Organization - the combining of many sources through overall administrative control
- Communications - creation of circuits to rapidly connect geographically distant sources
- Bidirectional Operation - provision for two-way flow of information between points in the network so that a user may also function as a source
- Directory and Switching Capability - the capability to identify and access to the best source(s) to satisfy a particular request.

In addition, a network can be further identified by the class of equipment used, the form of the data, and the overall function. While these means of identification are useful, the primary goal of the survey was to gather information needed to create a network with the four characteristics mentioned previously.

The study rationale evolved was based not only upon general network characteristics but also upon information system characteristics, later to be supplemented by the anticipated inputs from the scientists working parallel to the information scientists on the development of the rating system and the model case studies. The study rationale is illustrated in Figure 1.

Table 2 represents examples of more detailed expansion of the information-system characteristics, categorized in Figure 1 as general, output, input, and internal.

Table 3 illustrates relationships of information-system characteristics to general network characteristics for the survey questionnaire employed in this portion of the research study. By following this logic, every effort was made to relate specific questions in the survey questionnaire to specific network considerations. At the same time, it was desirable to keep the questionnaire to a minimum, in recognition of the busy schedule of the EHS personnel who would be responsible for preparing the replies.

Actual design of the questionnaire was based on prior information-system-survey studies(6-8) as well as on study of other related works(3, 9-13) in order to encourage ease and completeness of response.

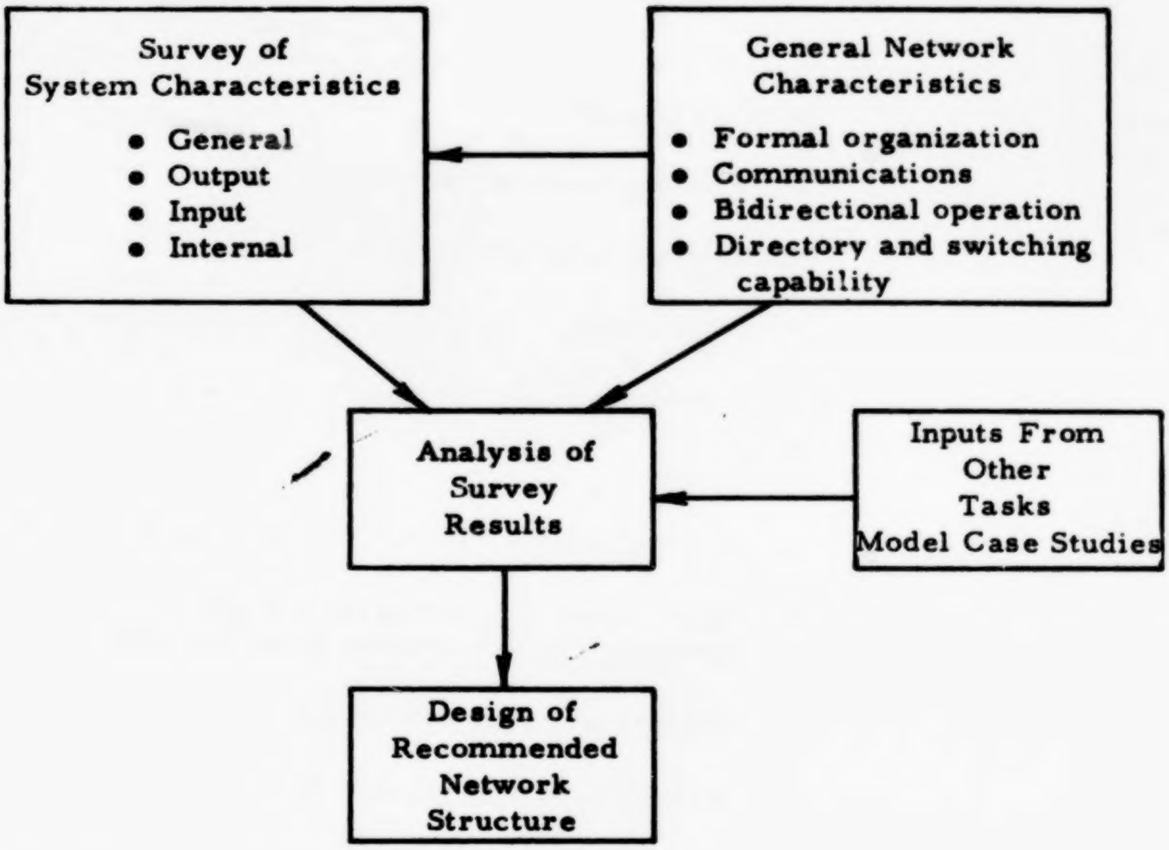

Survey of System Characteristics
General
Output
Input
Internal
General Network Characteristics
Formal organization
Communications
Bidirectional operation
Directory and switching capability
Analysis of Survey Results
Inputs From Other Tasks
Model Case Studies
Design of Recommended Network Structure

FIGURE 1. RATIONALE FOR SURVEY IN CREATION OF NETWORK STRUCTURE

TABLE 2. EXAMPLES OF DESIGN PARAMETERS RELATED TO INFORMATION-SYSTEM CHARACTERISTICS

Characteristics	Parameters
General	**Mission (objectives)**
	Scope (subject areas covered)
	Availability (user audience)
Input	**Nature of input**
	(1) Bibliographic, abstracts, indexes
	(2) Data
Output	**A. Bibliographies, accession lists, photocopies**
	B. State of the art, technical analysis, direct answers to inquiries (Information Analysis Centers)
	C. Data (without modification)
	D. Analyzed or manipulated data
Internal	**A. Information storage and retrieval system design (computerized, manual)**
	B. Library (manual)
	C. Data retrieval device (often computer)
	D. Data manipulation device (usually computer)

TABLE 3. RELATION OF QUESTIONNAIRE TO GENERAL INFORMATION NETWORK CHARACTERISTICS

System Characteristics		Formal Organization	Communications	Bidirectional Operation	Directory and Switching Capability
General					
1.	Name of information activity	■			■
2.	Name of parent organization	■			■
3.	Responsible individual	■			■
4.	Address		■		
5.	Telephone number		■		■
6.	Year started				■
7.	Activity status				■
8.	Mission	■			■
9.	Major subject fields (scope)	■			■
10.	Supplemental background material	■			■
Input					
11.	Types and sources			■	■
12.	Sources of monitoring data			■	■
13.	Contemplated input changes			■	■
Output					
14-15.	Performance of nonquery service				■
16.	Types of query services			■	■
17.	Form of query services			■	■
18.	Response time		■		
19.	Technical communities served				■
20.	Nature of user audience			■	■
21.	Limitations on use			■	■
22.	Cost of services			■	■
23.	Contemplated output changes			■	■
Internal					
24.	Storage media (documents)		■	■	
25.	Indexing practices			■	■
26.	Storage media (indexes)			■	
27.	Index vocabulary control			■	
28.	Number of indexing terms used			■	
29.	Thesaurus development			■	
30.	Formats for computer manipulation		■	■	
31.	Equipment used		■	■	
32.	Contemplated equipment changes		■	■	
33.	Personnel				■
34.	Information service contacts	■		■	

In its final form, as shown in Appendix A, the questionnaire contained 34 questions* subdivided into the four categories of information-system characteristics. After testing, it was found desirable to include a brief sheet of instructions clarifying the intent of some questions. This, too, is included in Appendix A.

The questionnaire was then tested by attempting to complete several surveys by using the information contained in the Hause and OST reports which were presumably representative of the existing EHS information system. The test showed that a maximum of 57 percent of the information requested on the survey form could be obtained from the reports. This confirmed the necessity for distributing the questionnaire to the facilities in order to obtain the desired data.

The Survey Population. On the basis of the Hause Report and other sources, the research team compiled a list of 50 candidate information resources within the three Administrations (NAPCA, ECA, and FDA) which, at that time, made up the Consumer Protection and Environmental Health Service. This list, shown in Table 4, was only a guide to the selection of information facilities to be included in the survey. Deletions, combinations, or additions were invited whenever the knowledgeable individual in each administration judged a change desirable.

Of the 50 identified information facilities, 31 were within the FDA, and as such were classed as possible outside resources at the time of separation of FDA from the EHS organization. While this list represented the facilities suggested for survey coverage as indicated by the literature, the actual distribution of the survey form was handled by EHS personnel more familiar with current in-house information activities. Therefore, dissemination of the survey form resulted in responses from additional resources not included in the original survey list. At the time the survey was completed, 12 forms had been returned for EHS facilities.

Other EHS Information Facilities. As the investigating team reviewed the EHS Indexes of Current Projects** and Operating Plans for FY 71 for NAPCA(14), ECA(15), and FDA(16), as well as the FY 71 Management Plan for the Office of Administrator(17), additional information resources were revealed. Examples of these facilities are:

- Air Pollution Regulation System
- Emergency Operations Control Center
- Federal Facilities Air Pollution Inventory Program
- Fuel Additives Register
- Intelligence Center on Batteries.

Such activities are normally not thought to be part of an information network since they are not based upon published literature (e.g., books, journals, reports, etc.); but, from the viewpoint of their contribution of specialized information and data of interest to those concerned with the environment, they can be invaluable. For example, the investigating information scientists, working with the scientific team concurrently

---

*The original questionnaire contained 76 detailed questions related to network characteristics. This was determined to be too detailed and extensive to expect reasonable response.

**See pages 47-51 for further discussion regarding this Index.

TABLE 4. SURVEY POPULATION OF EHS INFORMATION FACILITIES

National Air Pollution
Control Administration

Air Pollution Technical Information Center
Storage and Retrieval of Aerometric Data
Technical Audio-Visual Material Section
Technical Information Methods Section
Technical Publications Section

Environmental Control Administration

Basic Data Section – Disease Studies and Quality Control Laboratory
Bureau of Radiological Health Library
Central Library (National Center for Urban and Industrial Health)
Gulf Coast Marine Health Sciences Laboratory Library
Information Service Room – Injury Control
Medical and Occupational Health Radiation Program
Northeast Marine Health Sciences Laboratory Library
Pacific Northwest Marine Health Sciences Laboratory Reprint File
Radiotoxicology Information System
Reference Support Service
Research Grants Information System
Solid Waste Information Retrieval System
Standards and Intelligence Branch
Toxicology Unit – Disease Investigation System

Food and Drug Administration

Adverse Reaction Reporting System
Analytical Methods Storage and Retrieval System
Antibiotic Formulation Petitions, FDA Petition Files
Central Retrieval Index (CRI)
Color Additive Petitions, FDA Petition Files
Directories, Labeling Information
Drug and Chemical Dictionary
Drug Efficacy File
Drug Experience Information System
Drug Registration System
Feed Additive Petition, FDA Petition Files (Bureau of Veterinary Medicine)
Food Additive Petitions, FDA Petition File (Bureau of Science)
Infrared Spectra Storage and Retrieval System
Investigational New Drug, FDA Petition File (Bureau of Medicine)
Investigational New Drug, FDA Petition Files (Bureau of Veterinary Medicine)
Labeling Data Banks, Hazardous Substances (proposed)
Labeling Data Bank, Health Related Items (proposed)
Labeling Data Bank, Human Drugs
Labeling Data Bank, Veterinary Drugs (proposed)
Laboratory Instrumentation Systems Analysis
Literature Services
Microform Label File, Labeling Information
National Clearinghouse for Poison Control Centers
National Drug Code System, Labeling Information
New Drug Application, FDA Petition Files
New Drug Application, Drug and Premix
New Drug Application, Medicated Feeds
Pesticide Petitions, FDA Petition Files
Pesticides Information Center, Pesticides Intelligence System
RAPID (Retrieval of Automatically Processed Information on Drugs)
Science Information Facility

conducting the model case studies on lead and pesticides, were quite aware of the scarcity of certain types of information and data. While the information resources being considered here did not contribute the particular information/data required by the model case studies, their potential value to future studies was apparent.

Consequently, every effort was made to identify and contact as many of these focal points as possible in order to assure accurate descriptions for inclusion in the "Directory of Information Sources for the Environmental Health Service". By means of visits and telephone calls to the parties directly involved in the identified information activities, the research team was able to acquire a great deal of material pertinent to the project. The value of this process was further enhanced by the willingness of EHS personnel contacted to direct the research team to additional information channels of which the team was not yet aware.

Table 5 compares the scientific and technical information resources at the time of the Hause Report and the OST survey, and as determined by the Battelle survey. This comparison, which serves to illustrate the fluidity of such activities within EHS*, indicates the need for careful planning by the Service in establishing information activities to assure both their necessity and vitality once they are established. Further, the "Directory of Information Sources for the Environmental Health Service", prepared in conjunction with this study, will also be out of date within a short time if the fluid state continues. Steps should be taken by EHS to establish a continuing inventory of information resources within its jurisdiction as a referral service and switching station in order to assure full utilization of their services.

The intent of the survey was to identify system characteristics as related to information network characteristics. Hence, a rigorous statistical analysis of the responses was not intended. As indicated earlier, the survey was divided into four sections: (1) general, (2) input, (3) output, and (4) internal system characteristics. The information contained in the general characteristics section was intended to supply data for the "Directory of Information Resources for the Environmental Health Service". Brief summaries of the responses obtained for the remaining sections are presented below.

Input Characteristics. From the standpoint of input into these systems, the major sources of information were articles from journals, meeting proceedings, and review publications. Most of the systems also screened books and research and development reports, and incorporated abstracts, theses, and correspondence. Two or three of the systems relied primarily for their input on special sources such as clippings, personnel records, or specifications. In general, the systems responding to the survey used the open literature as their major input. None of the information facilities surveyed indicated that they accepted data directly from the EHS monitoring and surveillance facilities.

Of the seven activities indicating monitoring and surveillance data as a source of input, four stated that they relied on literature screening for such input. In other words, raw data or data summaries were not accepted into these systems. SAROAD collected aerometric data from Federal, state, and local agencies.

---

*At the time this report went to press, scope and name changes of some information facilities were still occurring. It was impossible to incorporate all changes in the final report.

TABLE 5. COMPARISON OF COVERAGE OF BATTELLE SURVEY WITH PREVIOUS SURVEYS

S = Survey Form; L = Literature; I = Interview; P = Phone Contact

Information/Data Activities	Management System Survey (Hause Report)	OST Review	Battelle Study
Air Pollution Regulation System, NAPCA			P
Air Pollution Technical Information Center (APTIC), NAPCA	L	L	S, I
APTIC Reference Library, NAPCA			S, I
Bureau of Radiological Health Library, ECA	L	L	S
Center for Air Environment Studies, NAPCA			P
Division of Biological Effects, ECA			S
Division of Electronic Products, ECA			S
Division of Medical Radiation Exposure, ECA			S
Emergency Operations Control Center, NAPCA			P
Federal Facilities Air Pollution Inventory Program, NAPCA			P
Fuel Additives Register, NAPCA			P
Intelligence Center on Batteries, NAPCA			P
National Aerometric Data System, NAPCA			P
Neighborhood Environmental Evaluation and Decision System (NEEDS), ECA			I
Office of Compliance and Standards, ECA	L	L	S
Radiation Incident Registry, ECA			S
Radioactive Materials Document Retrieval System, ECA	L	L	S
Radiotoxicology Information Center (SERHL), ECA	L	L	S
SAROAD (Storage and Retrieval of Aerometric Data), NAPCA	L		I
Scientific Reference Service, ECA	L	L	I
Solid Waste Information Retrieval System (SWIRS), ECA	L	L	S
X-Ray Exposure Control Laboratory, ECA	L	L	S

Eight of the facilities within EHS did not contemplate any changes in their inputs. Of those anticipating some type of change in the near future, one was planning to begin processing information that was on microfilm into the file; another was incorporating mark-sensing forms as an input device. Consolidation of multiple information activities within the same agency or expansion of coverage of the system were other changes mentioned by three of the facilities.

Output Characteristics. The primary nonquery services offered by EHS information activities were accession lists of new acquisitions and copying service. About half of the 12 activities offered these services. Some of the other nonquery services cited by several activities included permuted indexes, thesauri, selective dissemination of information (SDI), translations, interlibrary loans, and journal routing. State-of-the-art reports, special bibliographies, and reviews were cited by only one or two sources and were not a primary product of the EHS information activities.

The type of reference and query response services most often performed were searches of activity holdings and referral to other information sources. Prior art searches were also conducted by almost half of the respondents. Three of the respondents offered no reference or query response services.

The form of response furnished the user was overwhelmingly in the following categories: document (accession) numbers, bibliographic citations, citations plus abstracts, or full-size documents. No responses had technical analytical content. All of the activities answered at least half of their inquiries within 1 week and about half answered all of their inquiries within that time period.

All of the systems indicated that they provided information for technically oriented individuals at the Federal level. About half indicated that they served individuals within the state governments, and a few indicated that they provided information to the general public. Most of the systems indicated the availability of their information to users outside their own organization, although three stated that only bureau or administration staff could use their services. For those providing services to outside users, there was no charge.

Eight of the systems indicated that they also provided information to individuals in management positions as well as to the technical staff. The number of management personnel served was consistently smaller than the research users, indicating that all systems were oriented toward the researcher. This was to be expected, as strictly management-oriented systems were not considered within the scope of the survey.

About half of the facilities did not anticipate any change in output services. For those indicating some change, the following areas were mentioned: greater use of the computer, improved coordination with other similar activities (switching), and increased coverage of the literature.

Internal Characteristics. The information activities were also asked about operational characteristics such as storage medium of documents, type of indexes maintained, and items covered in their indexes. All of the information activities stored their documents in full-size form. Three stored some material in microform as well, and one system used a semiautomated unit record storage device (edge-notch device). All systems provided access to these documents through subject indexes. Almost all systems also provided author, corporate author, title, and accession number indexes. Two or three systems provided trade name, report number, and document-type indexes. More than half of the systems used permuted and inverted indexes as well as alphanumeric indexes of the traditional type. Two of the systems, functioning primarily as libraries, used traditional library classifications.

The medium of storage of the indexes was primarily on file cards, but over half of the systems also used "peek-a-boo" or optical coincidence equipment for storage of the indexes. Almost half of the facilities also used book-form indexes, primarily of the KWIC/KWOC type. One facility used an edge-notch indexing technique. (These systems were located in a single bureau.)

Information was also gathered about vocabulary structure to determine compatibility among existing systems. Most of the systems did not use any recognized authority list or thesaurus. Six facilities developed their own thesauri and only two of those indicated use of the Engineers Joint Council Thesaurus(18) as a guide. Vocabulary size for those six facilities ranged from 200 terms to 1400 terms. (Consideration is given to the problems of a service-wide thesaurus in a later section of this report.)

Compatibility of machine-readable records was also investigated to determine what information might be combined or interchanged from facility to facility within EHS. Three facilities used similar punch-card formats as specified by IBM for input to a KWIC indexing program. No other compatible formats were identified. More than half of the facilities used Termatrex optical coincidence systems indicating compatibility at least in the type of equipment used. (Here again, the facilities were organizationally concentrated.)

All but one of the facilities had staffs of five or less. The one exception had a staff of ten. This facility (APTIC) also had six outside contracts for services such as abstracting, screening, or translating. Only one other facility used an outside source for abstracting.

There was very little indication on the survey forms of anticipated equipment acquisitions. Only one facility indicated in-house equipment needs and this was the desire for a copying machine. Some organizations indicated increased use of the computer in the future.

Coordination Versus Centralization

The survey of the existing information facilities within EHS made immediately evident the multiplicity of mission areas within ECA (e.g., radiological health, water hygiene, solid-waste management, occupational health and safety, and community environmental management), as contrasted with the single mission area of NAPCA (e.g., air pollution). Table 6 illustrates this effect.

Most obvious was the effect at the Bureau level. The NAPCA Bureaus were operationally oriented, all directed toward some phase of the air pollution problem. Thus, the mission area was unified at the administration level. The mission areas within ECA, however, were at the bureau level and each bureau was concerned with a distinctly different mission area.

TABLE 6. SUMMARY TABLE OF TOTAL EHS INFORMATION AND DATA SOURCES

Numbers refer to facilities and descriptions contained in "The Directory of Information Sources for the Environmental Health Service." Information resources are presented in bold type; monitoring and surveillance activities are presented in light type.

Location of EHS	ECA					NAPCA*			
	Bureau or Office					Bureau or Office			
(A) Information Data Resources (B) Monitoring and Surveillance Activities Subunits	Bureau of Community Environmental Management	Bureau of Occupational Safety and Health	Bureau of Radiological Health	Bureau of Water Hygiene	Bureau of Solid Wastes Management	Bureau of Abatement and Control	Bureau of Criteria and Standards	Bureau of Engineering and Physical Sciences	Office of Technical Information and Publications
Administrative Office									2, 3
Bureau Office			4, 17, 18		20	8			
Division			12, 13, 15, 22			6		9	
Branch	11	21,**A-15, A-17**	14, 16, **A-3, A-4,A-6, A-8,A-11, A-12,A-19, A-20,A-21, A-29**	**A-9,A-13, A-28,A-30**	**A-18,A-27**	**A-23**		**A-5**	
Section						1, 7, **A-1, A-16,** 10, **A-25**			
Unit							19, **A-2, A-7,A-10, A-14,A-22, A-24,A-26**		

---

[*] In addition, the Center for Air Environment Studies is jointly sponsored by the Office of Manpower Development, Office of Research Grants, and the Office of Contract Development.

The focus of NAPCA upon one, although admittedly broad, subject area permitted NAPCA to establish two facilities at the administration level, the Air Pollution Information Center (No. 3 in Table 6) and the Air Pollution Regulation System (No. 2). Both of these constituted a valuable source of information and data for the entire NAPCA organization.

Within ECA, similar efforts were much more fragmented and at lower organizational levels. For example, the Bureau of Radiological Health Library (No. 4), the Radiotoxicology Information Center (No. 18), and the Solid Wastes Information Retrieval System (No. 21) were all at the bureau level. This fragmentation was further evidenced by the Division of Biological Effects library (No. 6), the Division of Electronic Products library (No. 7), and the Division of Medical Radiation Exposure library (No. 8). Each of these subject areas was distinctly different and, rightfully, the staff members of each division needed different information resources. The Radioactive Materials Document Retrieval System (No. 17) and the Scientific Reference Service (No. 20) which reported at the branch level appeared to be established at too low an organizational level, however, for it seemed likely that their services should be of wider benefit.

The same analysis applied to the specialized centers such as the Emergency Operations Center (No. 9) and the Fuel Additives Register (No. 11) in NAPCA, as contrasted to the Neighborhood Environmental Evaluation and Decision System (No. 14) and the Radiation Incident Registry (No. 16) within ECA.

Not only the difference in mission areas, but also the geographical dispersion should be considered. Personnel in Cincinnati should have nearby books, journals, and reports with which to work, just as personnel in Rockville require their tools. ECA had apparently done an excellent job in assuring the availability of information tools at the working level despite very fragmented situations. The fragmentation of the ECA effort to the bureau levels resulted in these facilities being closer to their particular user audiences and probably more user oriented than would be likely under centralized conditions.

However, as the information storage and retrieval systems employed by the information resources are replaced by computerized methods, economics may demand centralization and the use of remote terminals, facsimile, and telephone communications. The indexing and abstracting functions and the information storage and retrieval functions could be centralized without detriment by using modern means of communication. Under the present conditions of decentralized operations, the libraries cannot be centralized.

Information Resources Versus Planning, Programming, and Budgeting System Functions

In order to determine what information resources were available to EHS to support the planning, programming, and budgeting system functions upon which the EHS Operating Plans for FY 70-71 were based, the information resources in relation to PPBS functions served were tabulated. Definitions of the nine PPBS functions are given in Table 7, while the information resources listed in the "Directory of Information Sources for the Environmental Health Service" are given in Table 8.

TABLE 7. THE NINE PPBS FUNCTIONS

Research & Development - Efforts to obtain fuller scientific knowledge in areas of concern to CPE; application of available knowledge toward development, design, and initial testing of a prototype of a new method, process, device, etc. Excludes routine product testing, quality control, etc.

Demonstration & Testing - Experimental or operational testing of a new method, process or device; operation of a method, process, device, etc., which has already been developed and tested so as to facilitate its application.

Training - Long- or short-term training to increase the number of persons trained in occupations of concern to CPE or to improve skills of persons already trained. Includes development of training methods and improvement of educational resources.

Criteria & Standards - Development and promulgation of rules, standards, or levels of quality or quantity for environmental media, agents, or consumer products. These guidelines may be either enforceable or voluntary.

Surveillance & Intelligence - Collection of data through sampling, monitoring, epidemiological studies, laboratory analysis, etc., to determine environmental or consumer-product conditions and industry practices as basis for establishing standards, taking corrective actions, etc.

Compliance - Efforts to secure compliance with standards, rules, laws, etc., either through legal action or voluntary means.

Public Information - Efforts to inform the general public or special groups about the activities of CPE or inform them of special environmental health or consumer protection problems.

Technical Information - Efforts relating to the acquisition, storage, retrieval, and dissemination of scientific and technical information.

Program Assistance - Assistance furnished to state and local governments, other Federal agencies, industry, etc., to improve their capabilities. Assistance may be in the form of financial support, assignment of personnel, consultation, provision of technical services, etc. Includes support of state and local planning activities.

Source: Memorandum from Thomas O. King, dated December 16, 1968, entitled "FY 69-70 Operating Plans - Activity Definitions".

TABLE 8. FUNCTIONAL CATEGORIZATION OF INFORMATION RESOURCES BY PPBS CATEGORY[a]

Surveillance and Intelligence	Technical Information	Compliance	Criteria and Standards	Research and Development
Inside EHS Coast Guard Water Supply Sampling Project Pasteurized Milk Network Institutional Total Diet Sampling Network Alaskan Surveillance-Caribou & Reindeer Sampling Network Alaskan Surveillance-Human Measurement Bovine Thyroid Network Human Bone Network Nuclear Facility Environmental Analysis System Water Hygiene Analysis System Community Water Supply Study Interstate Carrier Watering Points Surveillance of Drinking Water Quality National Survey of Community Solid Wastes Practices Storage & Retrieval of Industrial Solid Wastes Data Regional & Abatement Area Surveillance Project Major Industry & Process Emissions Surveys Categorical Pollution Emissions Surveys Air Shed Emissions Surveys Pollution Source Inventory Source Survey of Specific Air Pollutants Abatement Monitoring Projects National Motor Vehicle Emissions Surveillance Program Pollutant & Effects Network Continuous Air Monitoring Project Radiation Alert Network Atmospheric Turbidity Monitoring National Occupational Health Monitoring System PAHO Cooperative Surveillance Project Tritium in Surface Water National Injury Surveillance & Epidemiology System	Inside EHS Scientific Reference Service Toxic Chemical Information System APTIC Reference Library Air Pollution Technical Information Center Division of Electronic Products X-Ray Exposure Control Laboratory Division of Medical Radiation Radiation Incident Registry Division of Biological Products Bureau of Radiological Health Library Solid Wastes Information Retrieval System Radioactive Materials Document Retrieval System Radiotoxicology Information Center SAROAL Neighborhood Environmental Evaluation & Decision System Fuel Additives Register Federal Facilities Register	Inside EHS Interstate Carrier Watering Points Surveillance of Drinking Water Quality National Survey of Community Solid Wastes Practices Storage & Retrieval of Industrial Solid Wastes Data Water Hygiene Analysis Systems Abatement Monitoring Projects Office of Criteria & Standards (Bu Rad Health) Legal Retrieval System Emergency Operations Control Center	Inside EHS Office of Criteria & Standards (Bu Rad Health)	
Outside EHS Air Quality Monitoring (Dept. of Agriculture) Air Pollution Problems in the Northeast (D. A.) Air Monitoring - Pesticides (FDA) Water Quality Data Program (D. I.) National Water Pollution Surveillance National Water Quality Data Network Water Data Information Communicable Disease Surveillance Activities in U. S. Water Quality Storage & Retrieval System (STORET) Nuclear Safety Information Center	Outside EHS Military Entomology Information Center Water Resources Scientific Information Center National Agricultural Library Pesticides Information Center Council on Environmental & Public Health Air Pollution Control Association Industrial Medical Association Archive Library (AMA) Bay Area Pollution Control District American Petroleum Institute Environmental Affairs Library Nuclear Safety Information Center International Atomic Energy Agency American Industrial Hygiene Association Industrial Hygiene Foundation of America Information Center for Internal Exposure Defense Documentation Center (DDC) Clearinghouse for Federal Scientific & Technical Information HUD Clearinghouse Science Information Exchange National Library of Medicine (NLM) Science & Technology Division (Library of Congress) National Referral Center for Science & Technology U. S. Dept. of Housing & Urban Development Library Water Resources Scientific Information Center	Outside EHS Air Pollution Control Association Aspen Systems Corporation Bay Area Pollution Control District	Outside EHS Nuclear Safety Information Center	Outside EHS Center for Air Environment Studies HUD Clearinghouse Science Information Exchange

(a) Duplicate entries are intentional and are due to the arbitrary assignments made by the research team.

Blank Page

The EHS formally organized information resources consist primarily of mission-oriented scientific and technical information activities, specialized monitoring and surveillance activities, and to a lesser extent, activities directed toward compliance.

It is realized that all of the information resources, monitoring and surveillance facilities, and data centers contribute to the R&D activity. However, no single EHS facility was identified, either within the Headquarters Element or within the several components, which had the responsibility for accumulating the research results of the service. EHS and its components are attempting to establish project information systems* but none of these efforts seek to function as the clearinghouse for completed research. This lack should be corrected within the EHS information network.

The function of Criteria and Standards was rather sparsely supported by one information resource within EHS, in the Bureau of Radiological Health of ECA.

The function of public information does not appear in Table 8. The research team took the position that the role of public information differed substantially from the other PPBS functions in its relationship to management information requirements. The rest of the represented functions are essentially potential contributors to satisfaction of management's information needs; the public information function is essentially a mechanism for the dissemination of repackaged management knowledge in lay terminology to parties outside the organizational structure. While this dissemination mechanism plays an important role in representing to the public the mission and accomplishments of EHS, the research team elected to exclude further consideration of public information from the study.

The balance of the PPBS functions – program assistance, training, and demonstration and testing – were not particularly evident as components of an EHS information network during this investigation.

This separation between information/data resources which are currently providing information support to the PPBS functions and those which are not indicates the existence of an information gap. The responsibility for examining the Administration Operating and Management Plans to determine the extent and the priorities to be exercised to fill the gap should be that of the Director of EHIN and his Advisory Council.

Conclusions Based Upon Survey of EHS Information Facilities

The member administrations of EHS appear to have recognized their information needs and have moved to meet them. On the basis of the observations of the project team (qualified by the impossibility of studying each facility to the depth desired) it appears that all the information resources that have developed serve useful needs within EHS.

Three factors of importance in determining the need for a given facility are demand, subject area, and geographical location. These three factors will play a continuing role in fragmentation (and possible overlap) of library holdings. While this aspect was beyond the scope of this study, such overlap would not be viewed with alarm unless it consisted of direct duplication.

---

*See pages 47-51 for further discussion.

The information facilities appear to be assigned to the highest practicable administrative level in view of the singleness of mission at that administrative level. This is particularly evident in the three division libraries in the Bureau of Radiological Health. In addition to the fact that one division appears to be located in a building separate from the other two divisions, any attempt to combine the libraries into one would definitely result in mixing of unlike subject areas and nothing would be achieved from the viewpoint of the user.

Because of the diversity of subject area, demand, and geographical location, centralization should be developed only insofar as it is for the common good. It would appear more practicable to develop a network of information facilities, tied together administratively from the EHS Headquarters element. Communication between facilities and the sharing of developments and problems should be encouraged by EHS. Wherever practicable, common procedures and practices should be instituted unless there is evidence of harm to the direct mission of a given information resource. This would permit interchange with the least disruption of such resources, facilities, and/or personnel as might be required by EHS in its present fluid state.

Summary of Survey of External Information Sources. It was desirable to include in the "Directory of Information Sources for the Environmental Health Service" at least some of the major resources of importance to environmental health which were outside EHS jurisdiction. For this purpose, a list of 31 resources was selected for which a modified facility-characteristics form was filled out. The form used was the same as that for internal facilities; however, only that information required to fit an outside activity into the EHS network was collected. A summary of the general and output characteristics of those external facilities included in the directory would be useful in determining the general nature of activities likely to be of interest to EHS personnel. Obviously, as EHS becomes involved in an increasing variety of efforts, many new outside sources will be tapped. In addition, many of the sources included in the directory, such as the Science Information Exchange, are only entry points into the vast information structure outside of EHS. The following summary of characteristics describes the types of facilities of interest to EHS as identified by the Battelle team.

Of the 31 respondents, all but one were operational. The FDA Analytical Methods Retrieval System was in the implementation stage at the time of this survey. Over half of the sources were located in the Washington, D. C., area and all but one were located east of the Mississippi River. More than half of the activities were started after 1960 and almost one-fourth of them were started after 1965. This gives some indication of the rapidly changing picture of information resources.

Twenty-three of the external sources were located within government agencies, with all but three at the Federal level. Of the nongovernment information sources, all but one were of the association/institute/foundation type. Only one truly commercial enterprise was included.

Most of the nonquery services offered by the external sources were of the abstracting, bibliography compilation, or loan-service type. Many of the sources also distributed journals, reprints, reviews, books, and indexes, conducted selective dissemination activities, and held meetings or seminars.

Reference and query services most often performed were searches of activity holdings, retrieval of factual statements, and referral to other sources. Less than half of the activities performed prior art searches or prepared state-of-the-art reports.

The form of response was indicated as primarily bibliographic citations, documents in full size, or explicit factual statements. In the case of referral responses, of course, the response was a name, address, and/or phone number.

Almost half of the sources identified were organized primarily to serve the medical or health-science professions. Only three of sources were organized specifically to serve research-oriented individuals. Nearly half of the external sources had no restrictions on the qualifications of the users. For some of the government activities for which there was no charge, the users had to be government employees or contractors. A few of the nongovernment sources also required membership in their association or organization as a condition for use of their services.

About one-third of the sources had no charge for their services. Of those that did charge, more than half recovered only printing expenses. Many of the others used a sliding scale for determining the charges on the basis of services rendered.

INFORMATION SUPPORT TO THE MODEL CASE STUDIES

Purpose of the Model Case Studies

Concurrently with the study of the EHS information system, two model case studies of stressors were undertaken by scientists expert in the study areas. The studies provided an opportunity to examine the information requirements of scientists in a real-time setting and to determine the types of resources that could be brought to bear upon such studies. As much as possible, on a concurrent basis, the studies were used to exercise all components of the system including the stressor matrix, the rating system, the predictive mathematical model, and most important to this phase of the study, the information network. This portion of the report describes the efforts to use the existing facilities and to ascertain their ability to provide the necessary information and data inputs for such studies.

Stressors

Early in the research study, through mutual agreement between EHS and Battelle, pesticides and lead were selected as environmental stressors of national concern for use in the model case studies. The literature for these two stressors was believed to be of both sufficient diversity and depth to provide a realistic test of the functioning of the known information resources.

Information Requirements

Lead Stressor

From preliminary examination of the literature, it was determined that the information requirements for the lead case study would include information and data on:

(a) Lead Mines and Reclamation Sites. Location, employers, production, number of employees, technologies, absenteeism, monitoring data (mine, community), health patterns (mine, community), and toxicological data, including mutagenesis.

(b) Lead-Compound Production. Identification of compounds, production, manufacturing or fabrication sites, number of employees, technologies, absenteeism, monitoring data, health patterns, and toxicological data. Also shifts in total production, in relative use patterns, and possible effects of these shifts upon public health.

(c) Lead and Lead Compound Use Patterns. Identification of uses in production, manufacturing, or fabrication of other consumer products, use of these products, and possible effects of use upon public health.

(d) Specialty Lead Compounds, Potentially New Lead Components. Delineation of selected categories from data obtained on lead mines and reclamation sites and lead-compound production.

Pesticide Stressor

It was determined that the information requirements for the pesticide case study would include information and data on:

(a) Number of people risking exposure to pesticides through the formulation, application, and usage of pesticides.

(b) Number of deaths, chronic illnesses, absenteeism, and other forms of illness occurring in these people.

(c) Pesticide utilization patterns in the U. S. according to method of application, specific pesticides, acreage, and rates of application.

(d) Present level of pesticides in the U. S. diet, general population, infants, and nursing mothers' milk.

(e) Transport of, or occurrence of, pesticides in nontarget organisms.

Identification and Acquisition of Information and Data

The conduct of the case studies required information and data inputs from various components of the information network, including the following:

(a) Environmental monitoring and surveillance activities

(b) Scientific and technical information sources

(c) Popular literature (including newspapers and trade journals)

(d) Personnel conducting research on the various aspects of the environmental lead and pesticide problems.

Accordingly, a list of prospective information sources was prepared using both the information and data needs established by the scientists and the information being collected for the "Directory of Information Sources for the Environmental Health Service". Appendix B presents the information and data sources utilized for the case studies.

Contrasting situations were encountered to the extent that a formal information activity, the Information Unit of the FDA's Pesticide Program, was identified and utilized for information concerning the pesticide stressor. No similar information activity was identified specific to the lead stressor. The latter situation would be the case most often encountered for other stressors of interest to EHS.

During the model case studies, the acquisition of information and data in response to the needs of the research team provided an opportunity to synthesize and test the functions of the various components of the proposed Environmental Health Information Network (EHIN)* prior to recommending a formal system to EHS. A schematic of the information flow and interaction between members of the research team during the model case studies is presented in Figure 2.

As specific requests for information and data were formulated, the requests were matched with the information sources deemed most apt to contain the desired information. The members of the project team responsible for the information-system portion of the study then performed a "switching center" function by submitting formal requests to the identified information and data sources.

Tables 9 and 10 present representative queries, the information source to which the query was directed, nature of the response, and appropriate comments for both the EHS and non-EHS sources, respectively. A list of journals, textbooks, and handbooks utilized during the model case studies is included in Appendix C.

In conjunction with identification of active research projects relating to the model case studies, members of the research team were directed to scientists conducting research on various aspects of the environmental lead and pesticide problems for additional information and data. This activity simulated a "referral center" function, demonstrating its potential value for inclusion in EHIN.

---

*For discussion of the proposed EHIN, see pp 95-96.

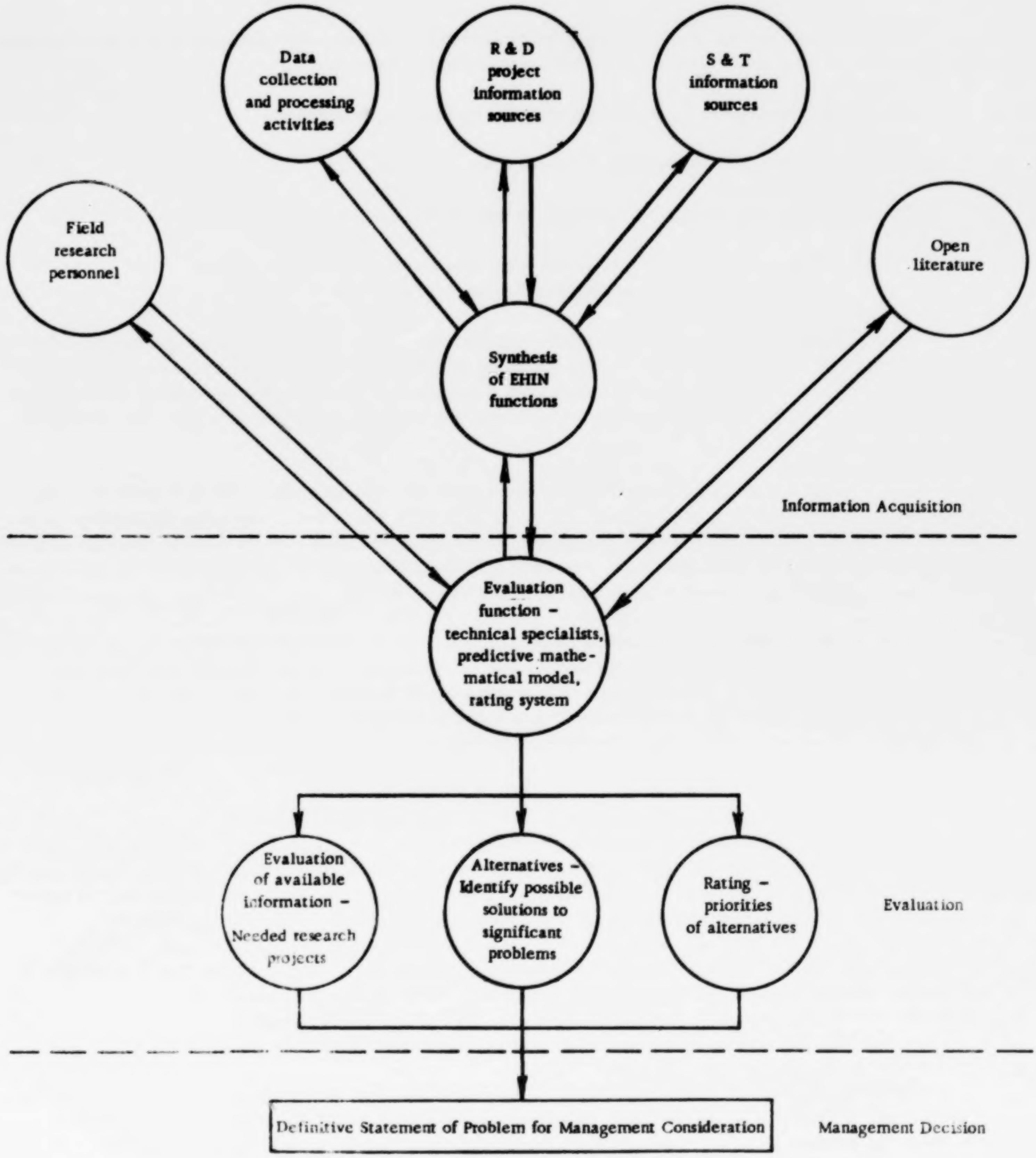

Data collection and processing activities
R & D project information sources
S & T information sources
Field research personnel
Open literature
Synthesis of EHIN functions
Information Acquisition
Evaluation function - technical specialists, predictive mathematical model, rating system
Evaluation of available information - Needed research projects
Alternatives - Identify possible solutions to significant problems
Rating - priorities of alternatives
Evaluation
Definitive Statement of Problem for Management Consideration
Management Decision

FIGURE 2. INFORMATION FLOW DURING MODEL CASE STUDIES

TABLE 9. EHS SOURCES CONTACTED FOR INFORMATION FOR LEAD MODEL CASE STUDY

Query No.	Query	EHS Source	Nature of Response	Remarks
1	What are the major uses of lead and the quantity of lead used per time period for each major user?	No identified EHS source for this type information	--	--
2	What are the emission rates of lead from major users to the air, water, and soil, listing by geographical region?	Air: M&S activities of NIAPEC, Bureau of Criteria and Standards, NAPCA Water and soil: No EHS coverage for emission rates	Their data available to NAPCA agencies only, without approval of the NAPCA commissioner	MSIIS would have to develop working relationship and regular data exchange channels with monitoring and surveillance activities of NIAPEC
3	What are the measured concentrations of lead in the air, water, and soil, listing by geographical region?	Air: SAROAD, Bureau of Criteria and Standards, NAPCA Water: National Water Quality Register, Bureau of Water Hygiene, ECA	Air: Data summaries Water: Data summaries Soil: No EHS coverage for soil.	--
4	What are the measured effects on individuals (children and adults) due to chronic exposure to lead?	APTIC, OTIP, NAPCA	Informative abstracts	Must have access to original documents for details
5	What is ultimate environmental fate of lead discharged into the atmosphere from the combustion of leaded gasoline?	APTIC, OTIP, NAPCA	Informative abstracts	Must have access to original documents for details
6	What are the anticipated major uses of lead during current decade?	No identified EHS source for this type of information	--	--
7	What is the annual incidence of lead poisoning of U.S. industrial workers?	Scientific Reference Service, Bureau of Occupational Safety and Health, ECA	PHS report and list of industrial processes with potential occupational exposure to lead	No information on incidence of lead poisoning
8	What is the incidence of lead poisoning annually of children?	No EHS source identified	--	--
9	How many working hours are lost annually because of lead poisoning?	Scientific Reference Service, Bureau of Occupational Saftety and Health, ECA	No information on this subject	--
10	What information is available concerning correlations of levels of lead in the air with levels of lead in the blood?	APTIC, OTIP, NAPCA	Informative abstracts	Must have access to original documents for details
11	What is the number of workers involved in lead mining operations, lead smelting and recovery operations, manufacture of lead storage batteries, TEL production?	Scientific Reference Service, Bureau of Occupational Safety and Health, ECA	No information on this subject	--

TABLE 10. NON-EHS SOURCES CONTACTED FOR INFORMATION FOR LEAD AND PESTICIDE MODEL CASE STUDIES

Query No.	Query	Source	Nature of Response	Remarks
1	What are the major uses of lead and the quantity of lead used per time period for each major user?	Lead Industries Association, American Bureau of Metal Statistics, U. S. Bureau of Mines, Moody's Industrial Manual	Publications, pamphlets, reports, etc., peculiar to each source	These sources were sufficient to determine uses and quantity used.
2	What are the emission rates of lead from major users to the air, water, and soil, listing by geographical region?	Water: STORET, FWPCA; no outside sources for air and soil	Presently obtain data for bodies of water only. Future plans are to obtain data from waters adjacent to industrial operations.	
3	What are the measured concentrations of lead in the air, water, and soil, listing by geographic region?	Water: STORET, FWPCA	Sampling data does not always include trace metals. STORET data available only to government agencies.	MSIIS would have to develop working relationship and regular data exchange channels with STORET.
4	What are the measured effects on individuals (children and adults) due to chronic exposure to lead?	MEDLARS	Indicative abstracts	Must have access to original documents for details
5	What is ultimate environmental fate of lead discharged into the atmosphere from the combustion of leaded gasoline?	No outside sources identified		
6	What are the anticipated major uses of lead during current decade?	Same as "1" above	Same as "1" above	Same as "1" above
7	What is the annual incidence of lead poisoning of U. S. industrial workers?	(1) Bureau of Mines (2) Bureau of Labor Statistics	Neither source could provide information on this subject.	
8	What is the annual incidence of lead poisoning in children?	(1) National Center for Health Statistics (2) LEA Associates (3) Baltimore City Health Department (4) National Association for Retarded Children (5) National Clearinghouse for Poison Control Centers (6) Commission on Professional and Hospital Activities	(1) No information on this this subject (2) Personal communication (3) In-house reports (4) Reprints	
9	How many working hours are lost annually because of lead poisoning?	(1) Bureau of Labor Statistics (2) Bureau of Mines	Neither source could provide information on this subject.	
10	What information is available concerning correlations of lead in the air with levels of lead in the blood?	MEDLARS	Indicative abstracts	Must have access to original documents for details
11	What is number of workers involved in lead mining operations, lead smelting and recovery operations, manufacture of lead storage batteries, TEL production?	(1) Bureau of Labor Statistics (2) Bureau of Mines (3) Office of Manpower Administration	Information from their publications	Generally speaking, the information was too superficial to be of much use.
12	What is the total population engaged in pesticide formulation, application, and usage?	(1) Information Unit, Pesticides Program, FDA (2) Bureau of Labor Statistics	(1) No information available on this subject (2) No information specific to pesticides	(2) Could furnish total figures for agricultural chemical industry but could not relate specifically to pesticides

TABLE 10. (Continued)

Query No.	Query	Source	Nature of Response	Remarks
13	How many deaths, absenteeism, chronic illnesses occurred in this population?	(1) Information Unit, Pesticides Program, FDA (2) Bureau of Labor Statistics (3) National Center for Health Statistics	(1) Reprints of studies dealing with health hazards of pesticides to workers (2) No information available on this subject (3) No information available on this subject	
14	What is present level of pesticides in (a) U. S. diet, (b) general population, (c) infants, (d) nursing mothers' milk?	(1) Information Unit, Pesticides Program, FDA (2) FDA Market Basket Surveys	(1) Reprints of pertinent studies (2) Copy of "Federal Regulation of Pesticides" contained numerous data summaries for pesticide levels in foods	
15	What is the pattern of pesticide usage in the U. S.?	Information Unit, Pesticides Program, FDA	No information on this subject; suggested agricultural research activities, USDA	
16	Can pesticides be reentrained through agricultural burning?	Information Unit, Pesticides Program, FDA	No information available on this subject	
17	What evidence exists for carcinogenicity of pesticides?	Information Unit, Pesticides Program, FDA	Referred to the "Report of the Secretary's Commission on Pesticides and their Relationship to Environmental Health" for the latest summary of information on the carcinogenicity of pesticides	

Evaluation of Information Response

Responses From the Information Resources

Responses from the information resources contacted during the course of the case studies consisted primarily of retrospective bibliographic compilations, reprints, government agency publications, trade association publications, and pamphlets. These responses were typical of the documentation center character of the bulk of the EHS and non-EHS environmental information resources. Very little analytical response, therefore, can be expected from the present facilities. Other responses were the data summaries from the monitoring and surveillance activities, and listings of on-going research projects compiled from publications such as those cited in References (19) and (20).

Before the various types of responses indicated above can serve the management decision-making process, they must be evaluated and integrated with each other and the total material interpreted in the light of management information requirements. These were the functions performed by members of the project team during the conduct of the case studies, and are functions which the EHS must be prepared to perform in the course of comprehensive environmental health planning activities.

Gaps in System Coverage

As the case studies progressed, certain needs were identified for which no EHS resource could provide the necessary information and data input. Most important among these needs were:

- Annual production of lead and lead compounds
- Lead and lead-compound use patterns
- Annual production of pesticides
- Pesticide application patterns (annual application in pounds per acre)
- Number of people currently and potentially affected by the stressors from both an occupational and community standpoint
- Nature and severity of the effect
- Sensitive population groups, e.g., young, aged, infirm.

Resources other than EHS were able to provide information relative to the first four needs listed above. However, accurate, documented information relative to the remaining needs was not found. For instance, data could be obtained for the total number of employees in the lead and zinc industry and in the agricultural chemical industry. However, within these groups, data relating to the actual number of production workers risking exposure to lead or pesticides were extremely difficult to obtain. The same was true for attempts to obtain data for other occupations involving potential exposure to lead or pesticides. It was even more difficult to obtain accurate data concerning the incidence of poisoning attributable to either lead or pesticides. Absenteeism or disability resulting from occupational exposure to either stressor was also unavailable.

Data of the above nature are considered to be essential input to the rating system. Consequently, EHS must be prepared to obtain accurate data for each new stressor considered during comprehensive health planning activities. Two systems currently undergoing development by the Environmental Control Administration may, when fully operational, provide useful data of the types discussed above. These systems are the National Occupational Health Monitoring System, and the National Injury Surveillance and Epidemiology System.

Information on the subacute, long-term exposures to the two stressors was also lacking. However, this was determined to be the result of a research gap, and not the lack of sufficient information coverage.

The information and data requirements for comprehensive environmental health planning activities, as demonstrated by the model case studies, go much beyond the subject-matter scope of the any single information facility. For instance, during the conduct of the case studies, a number of very different sources for the entry of the stressors into the environment had to be evaluated. Important among these sources were lead mining and reclamation operations, lead-compound production, industrial processes utilizing lead, transportation sources, pesticide formulations, pesticide applications, and reentrainment of pesticides through agricultural burning. The need to consider such diverse input sources necessitated identifying and utilizing equally diverse information resources. Included among the information resources were trade associations and their publications, government agencies and their publications, various industrial journals, and the scientific and technical literature.

In addition to the sources of entry, a number of environmental transport pathways had to be considered for each stressor. Among these were air, water, soil, foods, work environment, and home environment. Requirements for information and data of this type necessitated informational inputs of a much different nature and from entirely different resources. Attempts to obtain the necessary information and data were directed to the monitoring and surveillance activities, and to the scientific and technical information resources of various government agencies. In addition, the open literature was used extensively.

Knowledge of the physiological effect of the stressors for both acute and subacute, long-term exposure had to be ascertained. Also, information and data were needed concerning both the number of people currently and potentially affected by the stressors (population at risk) and sensitive population groups. Attempts to obtain information and data relative to these requirements were directed to various Government scientific and technical information resources, to various Public Health agencies, and to individuals conducting related epidemiological research. The open literature also was extensively utilized.

The above considerations are representative of the broad nature of the information and data required for just the lead and pesticide stressors. Other stressors will require the consideration of other sources of entry, other pathways, and other effects. Consequently, as additional stressors are considered by the EHS, new information sources will have to be identified and queried.

The identification and evaluation of potential threats and the development of means to counter or correct the threat situation require not only extensive and reliable environmental information and data, but also require accurate documented information and data concerning many nonenvironmental factors. The extent, nature, and broad diversity of the total environment precludes the concentration within any single agency of all necessary information resources and capabilities required to cope effectively with the complexities of today's environmental problems.

MONITORING AND SURVEILLANCE NETWORK

Background

Much of the present-day public expenditure for environmental research and control is directed toward the monitoring and surveillance of the components of the ambient environment. Through the efforts of the various monitoring and surveillance activities, large volumes of data describing the quality of the environment are being collected. In some instances such data are being collected in a real-time mode. Monitoring and surveillance activities can be expected to assume a larger role in future environmental management efforts as the need for their real-time input increases in support of comprehensive environmental health planning programs.

The Environmental Health Service is well aware of the importance of these activities and of the potential value of the monitoring and surveillance data resource in the management decision-making process. This awareness is evidenced by the fact that the EHS presently operates a large number of very diverse monitoring and surveillance activities, and a much larger number of on-going projects required to support and supplement the efforts of the true monitoring and surveillance projects.

In addition to the importance of its own programs, the EHS is equally aware of the value of developing access channels to those related environmental monitoring and surveillance activities either operated directly by other Federal agencies, supported by Federal funds, or operated by various state and local agencies. Collectively, the EHS and non-EHS activities represent an extremely broad base of information and data on nationwide environmental quality, surpassing the efforts and capability of any individual agency.

For the EHS to discharge its responsibilities effectively and thus serve as the single agency responsible for identifying health hazards in man's environment, and for developing programs for the control of such hazards, useful information and data must be provided to the higher administration and service levels. Providing this information to the management levels requires a mechanism at the interface between the management and operating levels of the EHS. This mechanism would have an in-depth awareness of both its own monitoring and surveillance activities and those of other Federal and private agencies. It would also serve to establish information and data exchange channels with these resources.

Inventory of Existing Monitoring and Surveillance Activities

A very large, extremely diverse, and potentially powerful information and data resource is represented by the environmental monitoring and surveillance activities brought together by the creation of the Consumer Protection and Environmental Health Service (CPEHS) in 1968. However, the very nature of the creation of CPEHS, by the merging of NAPCA and FDA plus the formation of ECA, brought with it the fundamental problem of identifying, organizing, and managing this resource in a manner most capable of providing CPEHS officials with the essential information and data outputs for discharging their responsibilities.

Past CPEHS Efforts

The value of this resource and the need to develop an organizational system at the management level which would provide in-depth knowledge of, and access to, the information and data collected and evaluated by this resource was recognized shortly after the creation of CPEHS. In response to this need, the R&D Steering Committee of CPEHS requested that information be collected regarding these activities and a list of the existing CPEHS monitoring and surveillance activities be prepared. This initial effort resulted in a compilation consisting of 168 activities covering the three Administrations.

This compilation reflected a very broad interpretation of a monitoring and surveillance activity, inasmuch as it included activities directed toward:

(a) Research and development

(b) Laboratory-analysis support

(c) Data processing and evaluation

(d) Design, development, and testing of monitoring methods, equipment, and instrumentation

(e) Training programs

(f) Technical and program assistance to other Federal, state, and local monitoring activities

(g) Enforcement of regulations

(h) Alerts, forecasts

(i) Accidents.

When the Food and Drug Administration was separated from CPEHS, and the name of the Service changed to the Environmental Health Service (EHS), the only effect upon the need to organize and improve access to the monitoring and surveillance activities was to remove the 19 FDA activities from further consideration. The basic problem of utilizing this type of resource as an effective management tool still remained.

In addition to the problem of developing a system capable of providing EHS officials with informational output from its own monitoring and surveillance resources, the EHS simultaneously recognized the need to identify and interface with other Government-sponsored environmental monitoring and surveillance activities.

Until this research project, no further action was taken by the EHS officials to develop a system to access its monitoring and surveillance resources.

Other Inventories of Monitoring and Surveillance Activities

In November, 1968, the Federal Council for Science and Technology, Committee on Environmental Quality, Subcommittee on Monitoring and Surveillance, released a draft compilation of monitoring and surveillance activities either operated directly by agencies of the Federal Government or supported by Federal funds. The purpose of this compilation was to characterize the nature, extent, and diversity of the total Federal program. This compilation consisted of 91 separate monitoring and surveillance activities, including 32 EHS activities.

The discrepancy in numbers of EHS monitoring and surveillance activities reported in the original CPEHS compilation and those reported in the FCST compilation was determined to be the result of the way monitoring and surveillance activities were defined by the two groups. When contrasted with the CPEHS interpretation given above, the FCST compilation defined a monitoring and surveillance activity as

> "One which has been or is intended to be repeated and which serves one or more of the following purposes: establish base lines; detect trends; enforcement of regulations; provide information for forecasts or alert warnings; contribute to the identification of potential hazards; or similar purpose."(21)

Excluded from this definition are research and development projects and nonrepetitive surveys.

Current Inventory of EHS Activities

For the purposes of this portion of the research effort, the FCST definition of a monitoring and surveillance activity was believed to be most representative of the type of activity that would be included in the EHS monitoring and surveillance network. Using this definition, the original CPEHS compilation was reexamined to exclude those supporting projects such as required for laboratory analysis of samples collected by the monitoring and surveillance activities; R&D projects to develop, test, and evaluate sampling methods and equipment; demonstration projects; program assistance projects; training programs; and short-term, nonrepetitive surveys.

As a result of this effort, 31 distinct EHS monitoring and surveillance activities that matched the FCST definition were identified. Table 11 lists these activities together with their purpose and the components of the environment with which they are concerned. Brief descriptions of each activity are presented in the "Directory of Information Sources for the Environmental Health Service". Because of the diverse nature of

TABLE 11. EHS MONITORING AND SURVEILLANCE FACILITIES

Monitoring and Surveillance Activity	Environmental Component Sampled										Purpose						
	Air	Water	Food	Man	Domestic Animals	Fish and Wildlife	Motor Vehicles	Injuries and Epidemiology	Occupational Health	Solid Wastes	Baselines and Levels	Detect Trends	Enforcement of Regulations	Forecasts or Alerts	Hazard Identification	Inventory Data	Effects Evaluation
Special Air Quality Field Studies	X										X						
Pollutant and Effects Network	X										X	X					X
Continuous Air Monitoring Project	X													X			X
Radiation Alert Network	X													X			
Atmospheric Turbidity Monitoring	X											X					
Regional and Abatement Area Surveillance Project	X												X				
Major Industry and Process Emission Survey	X															X	
Categorical Pollution Emissions Survey	X															X	
Air Shed Emissions Survey	X															X	
Pollution Source Inventory	X															X	
Abatement Monitoring Projects	X												X				
Source Survey of Specific Air Pollutants	X															X	
National Motor Vehicle Emissions Surveillance Program							X						X				
National Injury Surveillance and Epidemiology System								X							X		
Nuclear Facility Environmental Analysis System	X	X									X						
Pasteurized Milk Network			X								X						
Institutional Total Diet Sampling Network			X								X	X					
Tritium in Surface Water		X									X						
Bovine Thyroid Network					X						X						
Human Bone Network				X							X						
Pan American Health Organization Cooperative Surveillance Project	X										X						
Alaskan Surveillance – Caribou and Reindeer						X					X						
Alaskan Surveillance – Human Measurement				X							X						
Community Water Supply Study		X													X		
Surveillance of Drinking Water Quality		X											X				
Water Hygiene Analysis System		X											X				
Interstate Carrier Watering Points		X											X			X	
National Survey of Community Solid Waste Practices										X			X				
Storage and Retrieval of Industrial Solid Waste Data										X			X				
National Occupational Health Monitoring System									X						X		
Coast Guard Water Supply Sampling Project		X									X						

their activities and their dispersion throughout the operating levels of the EHS, it is desirable to review briefly a cross section of these activities.

NAPCA Monitoring and Surveillance Activities. Within NAPCA, the majority of the monitoring and surveillance activities are located in the Division of Air Quality and Emissions Data, Bureau of Criteria and Standards. The remainder of the activities are in the Division of Abatement and the Division of Motor Vehicle Pollution of the Bureau of Abatement and Control.

The National Air Surveillance Networks Branch of the Division of Air Quality and Emissions Data is operating monitoring and surveillance activities in the following areas:

(a) Special Air Quality Field Studies

(b) Pollutant and Effects Network

(c) Continuous Air Monitoring Project

(d) Radiation Alert Network.

Through the efforts of these activities, this Branch provides continuous monitoring of air quality, pollutant effects, airborne radiation, and contributes real-time reporting of data required during emergency situations. In addition, it maintains up-to-date information of state, local, and foreign air surveillance activities, and conducts special surveillance projects to fill gaps between routine surveillance and long-term special studies.

The data collected by these activities is processed into the SAROAD (Storage and Retrieval of Aerometric Data) system for future retrieval, evaluation, and publication.

The monitoring and surveillance activities of the National Inventory of Air Pollutant Emissions and Control Branch include:

(a) Major Industry and Process Emission Survey

(b) Categorical Pollution Emissions Survey

(c) Air Shed Emissions Survey

(d) Source Survey of Specific Air Pollutants.

The data collected by these activities are used to develop inventories of the nature, extent, and patterns of air-pollutant emissions and the practices used in their control. The data are also used in projecting trends in air-pollutant emissions. No routine storage and retrieval of the emissions data is practiced at the present. It is significant to note that the data are being retained in accordance with future plans to implement an Emissions Data Bank. However, the actual disposition of the data will await the outcome of a study being conducted by the Data Standardization Work Group of NAPCA. The possibility exists that the data may become a part of the SAROAD system, thus creating a National Aerometric Data System consisting of two parts: ambient air quality data and emissions data.(22)

In order to assess the scope, nature, and extent of interstate air pollution, and to gather the intelligence necessary to establish effective abatement control plans, the Division of Abatement operates the following monitoring and surveillance activities:

(a) Regional and Abatement Area Surveillance Project

(b) Pollution Source Inventory

(c) Abatement Monitoring Projects.

The Division of Motor Vehicle Pollution operates the National Motor Vehicle Surveillance Program. This activity surveys approximately 1500 motor vehicles to ascertain the quality of fuel emissions and compliance with the Clean Air Act of 1966.

ECA Monitoring and Surveillance Activities. The monitoring and surveillance activities which were a part of ECA at the time of the survey are, by nature of its responsibilities, more diverse than those of NAPCA, where the emphasis is on monitoring of air quality. Examples are given below.

The Division of Environmental Radiation, Bureau of Radiological Health, has the following activities under way:

(a) Nuclear Facility Environmental Analysis System

(b) Pasteurized Milk Network

(c) Institutional Total Diet Sampling Network

(d) Tritium in Surface Water

(e) Bovine Thyroid Network

(f) Human Bone Network

(g) Pan American Health Organization (PAHO) Cooperative Surveillance Network

(h) Alaskan Surveillance – Caribou and Reindeer

(i) Alaskan Surveillance – Human Measurement

(j) Coast Guard Water Supply Sampling Project.

Through the efforts of these activities, a system of surveillance on the exposure of the population to ionizing and nonionizing radiation from the testing or use of nuclear devices or nuclear power sources is maintained. Most of the data collected by these projects are published in the *Radiological Health Data and Reports*.

The Division of Technical Operations of the Bureau of Water Hygiene is presently conducting the following monitoring and surveillance activities:

(a) Community Water Supply Study

(b) Surveillance of Drinking Water Quality

(c) Water Hygiene Analysis System

(d) Interstate Water Carrier Points.

The data collected by these activities is used to evaluate and certify drinking-water supplies used by interstate and foreign carriers in the United States, and to evaluate the health hazards of drinking-water supplies with respect to source, treatment, purification facilities, and distribution systems.

The monitoring and surveillance activities of the Division of Technical Operations, Bureau of Solid Waste Management, include:

(a) National Survey of Community Solid Waste Practices

(b) Storage and Retrieval of Industrial Solid Waste Data.

The basic statistics collected by these activities are used to support the planning, development, and conduct of nationwide solid waste management programs.

The Division of Injury Control of the Bureau of Community Environmental Management operates the ...

National Injury Surveillance and Epidemiology System.

Through continuing surveillance of accidental injuries, this activity provides current information on the extent and nature of the problem and the detection of new and emerging hazards.

The Division of Occupational Injury and Disease Control of the Bureau of Occupational Safety and Health presently is developing the ...

National Occupational Health Monitoring System.

When in operation, this activity will conduct industrial hygiene surveillance of selected industries. The data collected will be used to develop guidelines and standards to ascertain the kinds of environmental problems associated with industry.

National Data Banks

The volume of data presently being collected by the monitoring and surveillance activities associated with the environmental sciences is larger and much more diverse than in most other fields. Furthermore, the community of users requiring environmental information and data inputs is correspondingly larger and more diverse than that encountered in other fields of endeavor. Consequently, environmental data may be required and collected for various reasons, including the following:

(1) Provide information and data for basic research

(2) Support operational missions

(3) Provide information for economic needs

(4) Establish base lines

(5) Detect trends

(6) Enforce regulations

(7) Provide information for forecasts and alert warnings

(8) Identify potential hazards.

Many of the data collected by the EHS and other agency monitoring and surveillance programs, either in the raw data form or in the reduced and interpreted form, can prove to be extremely valuable to other environmentally oriented programs and personnel. The data may be required and utilized by others for reasons entirely different from the requirements prompting the initial collection and utilization of the data. Consequently, owing to the expensive and time-consuming nature of the initial data-collection efforts, and the potential value of these data to other programs, the storage and retrieval of the data for future uses is important. As a result, national data banks, as described in the following paragraphs, are being established.

SAROAD

The SAROAD System operated by NAPCA's Division of Air Quality and Emissions Data is the only EHS national data bank with fully operational status. This system best exemplifies what can be accomplished by a national data bank and for this reason it is desirable to discuss SAROAD in more detail.

SAROAD is a computer-centered system for the Storage and Retrieval of Aerometric Data. It consists of a set of identification codes for stations and pollutants, a set of data-reporting forms, input programs, and data file and output programs to list, summarize, and analyze stored data. As early as 1958, the Public Health Service indicated the need for a computer-based data collection and processing system to support the National Air Sampling Network(23). Today, air monitoring programs are generating even greater amounts of data. These data often require extensive statistical analysis to be of significant use. Without the tools to perform such analysis, the data go unanalyzed or are merely reported in lengthy tables. In addition, state and local agencies are operating sampling networks that are generating many data useful to a national network as well as to local agencies. To these activities SAROAD offers a data-processing capability beyond the means of most local agencies. In return, the contributing groups present their data in the format required by SAROAD for processing. This provides SAROAD with a much broader base of data than if it merely relied upon internally generated air-quality data.

This entire approach toward collecting and analyzing data as a central clearinghouse function is significant in that it represents a good model for similar data-collection agencies in other areas within EHS.

It is possible that at some future time the SAROAD system will be superseded by a National Aerometric Data System(24) currently under development by the Data Standardization Work Group of NAPCA. From all indications, SAROAD or its successor will be the standard-setting and common collection point for all aerometric data collected in the U. S. by Federal, state, and local agencies. This proposed system is using as its basis the SAROAD system, but is intended to provide greater speed, flexibility, and ease of application. Much of the added capability is dependent upon the ready availability of a third-generation computer. The designing of the new system is in its final stages, but the actual implementation will require outside contractor support in the area of software. The actual date of implementation, therefore, is still unclear.

Other EHS Data Bank Activities

A review of the ECA Operational Plan for FY 1970-71 indicated ECA intentions to develop other national data banks similar to SAROAD. These data banks are being planned to accumulate data for the following areas: water quality, environmental radiation, and epidemiology.

When fully implemented, the net effect of these data banks will be to systematize the availability of environmental data and thereby provide a much broader intelligence base for use in comprehensive environmental health planning on a nationwide scale. Table 12 presents these activities in terms of the environmental parameters described by the data, the responsible EHS Bureau, the purpose or scope of the data base, and the system's operational status.

Water Quality Data Storage and Retrieval System

Another national data bank of interest to EHS, identified during the survey, was STORET (Water Quality Data Storage and Retrieval System). This activity is currently operated by the Federal Water Pollution Control Administration (FWPCA) to store and retrieve facilities' data and water-quality data collected by FWPCA for continuous comparison with water-quality standards. This system is described in the "Directory of Information Sources for the Environmental Health Service".

The Concept of a Monitoring, Surveillance, and Intelligence Information System (MSIIS)*

The size and diversity of the monitoring and surveillance activities within the EHS are apparent from the preceding discussion. As illustrated in Table 12, these activities are deeply enmeshed in the daily affairs of the operating levels. Consequently no attempt should be made to integrate or regroup these activities without careful study and evaluation. Accordingly this portion of the research effort was devoted to optimizing the monitoring and surveillance network, its functions in regards to EHS management information needs, and its integration into the existing EHS structure in a manner that would complement both the management information needs and the objectives of the Administrations.

---

*The terms "intelligence" and "alerting function" were considered synonymous by the research team for this activity.

TABLE 12. DATA BANKS PLANNED OR OPERATING WITHIN EHS

Environmental Parameter	Responsible EHS Bureau/Office	Purpose or Scope	Operational Status
Water quality	Office of Water Hygiene	To maintain a National Water Quality Register comprised of data collected from comprehensive surveys of U. S. drinking-water supplies	Development
Environmental radiation	Bureau of Radiological Health	To develop and operate a central facility for the collection, analysis, and regular dissemination of environmental-radiation surveillance data	Development
Epidemiology	Office of Human Ecology	To develop a centralized, automated epidemiologic data bank which will provide a single system to express all epidemiologic information developed or needed by the ECA	Development
Air quality	Bureau of Criteria and Standards, National Air Pollution Control Administration	(1) SAROAD System – A national data bank containing data on atmospheric concentrations from some state and local agencies, and all data from the National Air Surveillance Networks Branch of NAPCA	Operational
		(2) Emissions Data Bank – A data file for the storage and retrieval of companies, source emissions, and air-quality data collected by the National Inventory of Air Pollutant Emissions and Control Branch of NAPCA.	Development

To this end, it is recommended that an integrating information system be established within the EHS Headquarters Element. This system would be known as the Monitoring, Surveillance, and Intelligence Information System (MSIIS).

MSIIS should not duplicate either the monitoring and surveillance functions nor the data banks of the lower echelons. Rather, it should act as an interface between the EHS network and other networks.

The mission statement for MSIIS, as visualized by the investigating team, is presented in Table 13. Various aspects of MSIIS are discussed in the following paragraphs.

TABLE 13. MISSION STATEMENT FOR MSIIS

(1) To maintain an inventory and data source index for all EHS monitoring and surveillance activities, including data banks.

(2) To maintain an inventory and data-source index of other Federal, state, and local monitoring and surveillance activities, including data banks.

(3) To interface with Federal, state, and local monitoring and surveillance activities to obtain desired and consistent data for EHS areas of concern.

(4) To provide a referral and switching capability for EHS staff, contractors, grantors, and others to proper source of specific data as required.

(5) To provide EHS with an alerting system to increasing or new threats to the environment, based upon monitoring and surveillance data.

(6) To provide EHS with data for threat evaluation and other studies.

Inventory, Switching, and Referral Capability

Large data-collection activities are expensive and time-consuming efforts. The need to avoid duplication of activities and facilities, therefore, is great. The EHS must make as much use as possible of both collection and analysis facilities of other agencies now conducting active environmental monitoring and surveillance programs. The exact relationships between and with existing monitoring and surveillance programs will require careful consideration, but planning and exchange programs can lead to the attainment of effective cooperation and reasonable economies.

MSIIS should maintain a current awareness of other agency monitoring and surveillance activities, and related national relationships and data exchange channels with these activities. As earlier indicated, the monitoring and surveillance activities of the EHS and other Federal, state, and local agencies collectively represent an extremely broad base of information and data on environmental quality surpassing the efforts and capability of any individual agency. Therefore, the importance of establishing working relationships and data exchange channels cannot be overemphasized.

Interface With the Scientific and Technical Community

An important function of MSIIS will be to interface between the network and the user community. There will be increasing demands upon the network to provide data to the scientific and technical community for state-of-the-art reports, threat evaluations, and rating studies. The need for such data was evidenced by the model case studies, carried out as a portion of this research study, which are discussed in detail earlier in this report.

To this end, MSIIS should serve as a switching and referral center, evaluating requests for data, not only from the S&T community (EHS contractors) but from other Government agencies as well. In some instances, the request would be directed to an existing EHS data bank or to a specific monitoring and surveillance activity. In other instances, the requester would be directed to monitoring activities or data banks within other agencies.

MSIIS should be alert to continuing long-term needs of the S&T community for monitoring and surveillance data. Compilations of such data could be regularly prepared and disseminated through a scientific and technical information system, thus reducing demands upon the EHS network.

Alerting Function

A number of EHS monitoring and surveillance activities (see Table 11) currently are in operation to detect trends, provide information for forecasts or alert warnings, or contribute to hazard identification. However, mechanisms should be established not only to further the detection of but also to report any sudden or significant shifts in those factors regularly monitored by the network to a central activity with the responsibility for maintaining an overview knowledge of the environment from a monitoring and surveillance standpoint. MSIIS should establish such procedures and the criteria for alerts on the basis of careful evaluation of what constitutes a significant shift for the various elements monitored by the network.

With its in-depth knowledge of the total monitoring and surveillance resource, the MSIIS would assume the responsibility of ascertaining the extent of the threat and the possibility of its occurring in other components of the environment not monitored by the activity initially detecting the threat. The responsibility for initiating follow-up and/or any prescribed corrective actions would still remain at the present operating level and be conducted in accordance with established operating procedures.

Operating in the above fashion, MSIIS would enable the EHS to realize the full potential of an "alerting system" that goes beyond a particular mission responsibility and that could be applied to the broader requirements of comprehensive environmental health planning.

PROJECT INFORMATION RETRIEVAL SYSTEM (PIRS)

One of the expressed goals of EHS has been to develop a project information reporting system which "will serve the operational needs of all organizational levels and minimize the number of special requests for information already in such a system". (25) As indicated in an internal EHS memorandum(26) the project information retrieval system was intended to:

(a) Help the scientist or engineer determine the status and approach of EHS-supported efforts related to his own work

(b) Provide a rapid exchange capability for technical and management data on on-going work to all management levels

(c) Provide data on EHS to interagency data collection or coordination groups.

Evidence obtained during the course of this investigation indicated that the recommended design and implementation of PIRS should receive high priority within all management levels of EHS.

Current Status of Management Systems

Administration-Level Systems

Both NAPCA and ECA were developing project information reporting systems at the time the survey of existing facilities was made. At that time, the Office of Research and Development of ECA was developing a management system which would maintain records of grants, in-house projects, and contracts. It also was developing standardized formats. With the current redeployment of resources under way within EHS, the future role of this office and its management system remains unclear.

NAPCA also had a similar effort under way within its Management Systems Branch. At the time of this study, the system was just initiated and was receiving input at the task level. Certain inconsistencies were noted which might, in time, cause difficulty; these were as follows:

(1) While project control was on a monthly basis, project accounting was on a biweekly basis.

(2) Accounting codes were on an organizational basis.

(3) Project codes were not compatible within the Administration.

In addition to these administration-level efforts, there were program-level efforts such as the "Multi-Project Management System for (Air Pollution) Project Planning and Control"* which had the objective of providing the Process Control Engineering Program with a system for planning and control of engineering R&D activities performed by non-Federal contractors.*

---

*NAPCA Project No. A3616 titled "Multi-Project Management System for Project Planning and Control", Project Officer: P. W. Spaite, Process Control Engineering Program, Cincinnati, Ohio.

EHS-Level Developments

In conjunction with its Information Consultant, EHS has been developing a Service-wide project information system. A set of minimum required information elements (see Table 14) was developed by EHS and the member Administrations were directed to include all of these elements in future reports. A new reporting form was not developed; instead, the Administrations were encouraged to use their existing forms which contained most of the elements and to add any missing elements on an attachment. This was done in order to permit the continued development of a project information system at the administration level without undue disruption of existing systems.

Primarily on the basis of data obtained from a compilation of NAPCA projects and all grants active within the CPEHS Administration in February, 1969, several preliminary products were produced by means of existing computer programs. These products were not intended to represent a proposed management system, but merely to demonstrate the utility of such information and data.

The demonstration products consisted of indexes made by permuting the titles of the various research projects and grants for which information was available. The titles were "enriched"; that is, some additional terms were added to the title in order to make the title more meaningful and, at the same time, to assure that these terms appeared in the index. Indexes produced by permuting a title or sentence are known as either KWIC (keyword in context) or KWOC (keyword out of context) indexes.

Figures 3 and 4 represent two KWOC printouts.** The first figure illustrates a subject index giving only project titles and numbers. The utility of such an approach is diminished by the fact that the user then must refer to some other source for additional information.

Figure 4 is a KWOC index arranged by project numbers. While more management information is available from this printout, in order to obtain a full description of the project, the user would still be required to look at secondary sources such as the Research Objective Form or the project sheets. The number linking the enriched title entry in the KWOC to the Project/Grant List contains a suffix which is the Planning, Programming, and Budgeting System (PPBS) Code. This code can be used to organize output from the system.

As envisioned, the EHS-level project information system was to incorporate microfilm copies of the project sheets containing detailed information corresponding to the information elements shown in Table 14. Coverage was planned to include all administrations within EHS with respect to in-house projects, contracts, and grants. Emphasis was to be placed upon research and development, criteria and standards, and monitoring and surveillance information. The National Institute for Environmental Health Services projects and grants were the only outside inputs currently anticipated.

---

*This particular effort was identified by the research team through the EHS-generated KWOC index prepared as a pilot demonstration of the value of an EHS-level project information system.

**The investigating team found these listings extremely useful in identifying information activities.

2 OF 3

PB

194 411

TABLE 14. REQUIRED INFORMATION ELEMENTS

1. Project Number
2. Organization (to Division level)
3. Status
4. Fiscal Year
5. PPBS Program Category
6. PPBS Activity
7. Operational Objective
8. Project Title
9. Responsible Organization
    a. Name of the organization
    b. Postal address
    c. Responsible individual
10. Performing Organization
    a. Name of the organization
    b. Postal address
    c. Responsible individual
11. Project Type
12. Contract Number
13. Funding
    a. Total funds
    b. Contract funds
    c. Reimbursable funds
14. Work Area of Project Group
15. Start Date
16. End Date
17. Professional Man-Years
18. Project Plan (Text)
    a. Objective
    b. Summary
    c. Progress
    d. Current-year goals

A1531-11RD	411 W. Chapel Hill St., Durham, N C. 27701 $39,300.
A1532-11RD	Shy, C. M., M.D. Relation of Air Pollution to Severity of Influenza Epidemics Health Effects Research Program 411 W. Chapel Hill St., Durham, N. C. 27701 $71,700.
A1533-11RD	Horton, R. J. M. Effects of Air Pollutants on Natural Transmission of Infection Health Effects Research Program 1055 Laidlaw Avenue, Cincinnati, Ohio 45237 $25,400.
A1534-11RD	Shy, C. M., M.D. Cincinnati School Children Study/Pulmonary Function Results Health Effects Research Program 411 W. Chapel Hill St., Durham, N. C. 27701 $37,700.
A1535-11RD	Shy, C. M., M.D. Cincinnati School Children Study/School Absences and Air Pollution Health Effects Research Program 411 W. Chapel Hill St., Durham, N. C. 27701 $12,900.
A1536-11RD	Shy, C. M., M.D. Effects of Air Pollution on Newborn Children/5-Year Prospective Study Health Effects Research Program 411 W. Chapel Hill St., Durham, N. C. 27701 $69,700. Contract $55,000. Loyola University-Chicago Chicago, Illinois.
A1537-11RD	Newill, V. A., M.D. Air Pollution and Health in a Normal Urban Population Health Effects Research Program 411 West Chapel Hill St., Durham, N. C. 27701 $65,750. Contract $60,000.
A1538-11RD	Horton, R., Dr. Effect of Air Pollution on Chronic Respiratory Diseases in Twins Health Effects Research Program 1055 Laidlaw Avenue, Cincinnati, Ohio 45237 $5,750.
A1539-11RD	Newill, V. A., M.D. Medical Care (in Air Pollution Episodes) Project Health Effects Research Program 411 W. Chapel Hill St., Durham, N. C. 27701 $11,500.

FIGURE 3. SAMPLE KWOC INDEX OF RESEARCH PROJECTS ARRANGED BY ASSIGNED PROJECT NUMBER

Continuation

Children	
Cincinnati School Children Study/School Absences and Air Pollution	A1535-11RD
Effects of Air Pollution on Newborn Children/5-Year Prospective Study	A1536-11RD
Modification of High Risks Behavior in Children	UI00619-01
Chimney	
Pollutants in Chimney Stack Plumes	AP00578-01
Chip	
Pre-Pulping Chip Extraction to Reduce Air Pollution	AP00612-02
Chlorophyy	
Mechanism of Chlorophyy Biodegradation	UI00141-06
Chromatography	
Pollution Abatement by Process Gas Chromatography	AP00475-03
Laboratory Chromatography of Inorganic Pollutants	-A2008-14RD
Chromium	
Nitrate Determination Using Chromium II Complexes	UI00356-01
Chromosome	
Radiation Induced Chromosome Damage and Cell Response	RH00512-01
Chromosome Changes in Human After Benzene Poisoning	UI00465-02
Chromosomes	
Protection Against Radiation Damage to Chromosomes	RH00140-05
Chronic	
Environmental Factors and Chronic Bronchitis	AP00045-09
Chronic & Acute Toxicity of Auto Exhaust, Sulfur Dioxide, Nitrogen Oxides and (Lead Particulates)	A1500-11RD
Role of Air Pollution in Development of Chronic Respiratory Disease	A1531-11RD
Effect of Air Pollution on Chronic Respiratory Diseases in Twins	A1538-11RD
Cincinnati	
Cincinnati School Children Study/Pulmonary Function Results	A1534-11RD
Cincinnati School Children Study/School Absences and Air Pollution	A1535-11RD

FIGURE 4. SAMPLE KWOC INDEX OF RESEARCH PROJECTS ARRANGED BY PROJECT TITLES

KWIC/KWOC techniques are useful tools for providing two distinct types of products: (1) low-cost, current awareness types of products (e.g., Current Contents, published by the Chemical Abstracts Services) and (2) one-time listing, intended primarily for reference. Neither KWIC or KWOC are suitable as an in-depth search tool such as would be required as a basis for PIRS.

Outside Sources

Outside sources of EHS project information such as the Science Information Exchange (SIE) and the Division of Research Grants of the National Institutes of Health (NIH) were found to be incomplete. A recent search of SIE for contracts and in-house projects within NAPCA and ECA resulted in no returns for NAPCA and only eleven 1968 records for ECA. In addition, the investigating team found that NIH was not getting all the material from ECA.

PIRS Versus Administration/Bureau Systems

It was noted previously that both NAPCA and ECA were developing project information retrieval systems. Since NAPCA and ECA each had contracting authority, it was natural that they should seek to establish control over their grants, contracts, and internal projects. Further, the responsibilities of the Headquarters element of EHS to the Executive Branch and to the Congress require that it too have nearly identical capabilities, not only for projects administered by the EHS Headquarters element, but also for all projects administered by lower administrative levels.

However, the development within EHS of several independent project information systems with separate reporting methods is unnecessarily duplicative. It is logical that a Service-wide system be developed for the use of all concerned EHS personnel. By pooling of resources, much greater progress can be made toward establishment of a useful PPBS tool for all.

It is an administrative judgment where PIRS be located and who has responsibility for its performance. The point is that, in view of the national urgency currently being assigned to research in the area of environmental health, it is mandatory that a useful, centralized project information system be established and operational at an early date. A uniform project numbering system, uniform project reporting procedures, and an interchange of successful management techniques must be achieved as quickly as possible in order to meet the management responsibilities being thrust upon EHS and its component organizations if they are to fulfill their role within the national goals.

Care should be taken not to dilute the effectiveness of PIRS by combining PIRS with other disparate administrative data. Accounting procedures for payment to contractors and grantors properly belong at the administration level managing such contracts and/or grants. Such administrative systems, however, should be separate from a Project Information Retrieval System.

Design Parameters of PIRS

Mission

On the basis of the preceding considerations, it is possible to define the mission statement for PIRS as shown in Table 15. The mission statement is divided into primary and secondary objectives. The investigating team considers the primary objectives to be mandatory for a successful PIRS. The secondary objectives represent options which can evolve from continued operation of the system.

The choice between primary and secondary objectives is not necessarily based upon order of importance but, rather, practicability of early achievement. For example, the problem of acquisitioning complete data in order to accomplish the secondary objectives would be very difficult and would require extensive surveys. Establishment of a workable PIRS should not be delayed by attempts to include the secondary objectives.

Response Time

In order to be effective, PIRS must be responsive to the demands placed upon it. Response time is extremely important and the acceptance of such a system will depend to a large extent upon its ability to respond in a timely fashion. This is particularly true in view of the diverse locations of the EHS administrative units.

Content

Before attempting to structure PIRS, it first is necessary to visualize the types of demands which may be placed upon it. For this purpose scenarios have been developed to attempt to illustrate specific types of questions which might be asked of PIRS. These are listed in Table 16. While the questions are by no means exhaustive, they do represent varying levels of complexity of response. They include questions that might be asked of PIRS by working bench-scientists as well as questions that might be directed by a manager primarily concerned with PPBS. As the PIRS concept evolves, the scenarios should be further expanded and refined to assure the effective development of the PIRS system.

Examination of the scenario's content leads to the conclusion that the data base of PIRS should not be limited to current EHS projects. For example, Scenario 3, "Identify all completed projects on Subject X", is a query which could be directed to EHS by Congress and one for which Congress should reasonably expect a quick and accurate response. Yet, the ramifications of such a simple question raise others since its answer requires a historical inventory of past projects:

(a) Should the response be limited to only EHS projects or should PIRS provide a response which shows knowledgeability and coordination with sister agencies?

(b) The same applies to state, metropolitan, or municipal programs: Shouldn't EHS be aware of these efforts also?

TABLE 15. MISSION STATEMENT FOR PIRS

Primary Objectives:

1. Provide all EHS facilities with timely response on
    a. All on-going EHS-sponsored research
    b. All completed EHS-sponsored research.
2. Provide PPBS data to EHS management and the managements of constituent administrations and bureaus, with proper privacy blocks for sensitive data.
3. Interface with other Federal agencies to determine on-going research projects of concern to EHS and to alert them to EHS-sponsored projects.
    a. Such data should become a part of the EHS/PIRS store
    b. PIRS should assume EHS responsibility for listing research projects with the Science Information Exchange, NIEHS, and others.

Secondary Objectives:

4. Develop a historical record of all Federally sponsored research concerned with environmental health.
5. Interface with state, metropolitan, and municipal authority to ascertain on-going research projects.
6. Maintain a store of data on industrially sponsored research aimed at correcting environmental threats through products, processes, or manufacturing residues.

TABLE 16. SAMPLE PIRS INQUIRY SCENARIOS

Scenario	Query	Nature of Response	Remarks
1	What work is EHS doing on Subject X?	(a) A simple list of project numbers and/or contract numbers	Would require user to refer to some other listing to get desired details.
		(b) As "a" above but with additional details, including some or all of following elements: project title, contractor, principal investigator, estimated costs, project dates, short work statement	Such systems are quite feasible. Uniform reporting should be instituted within all components of EHS.
2	What other agencies (Federal, State, metropolitan area, or municipality) are working on Subject X?	Same as above	Care must be taken to assure adequate indexing to include Subject X. Acquisition of data for inclusion in files becomes more difficult. Size of data base, and hence, storage, will become much greater, depending upon depth of coverage. Data on Federal activities should be available from the Science Information Exchange and other similar sources.
3	Identify all completed projects on Subject X	Same as Scenario 1 above	Such information should be available within PIRS on EHS-sponsored projects. Inclusion of data from other agencies would be costly in terms of both acquisition and computer storage.
4	What reports have been published on Project Y?	Listing of report numbers, titles, authors	Information on reports published as a result of EHS-sponsored research should be in PIRS for completed projects. Reports would be available in STIS.* Reports resulting from non-EHS-sponsored research should be identifiable and available through STIS.
5	What reports have been published on Subject X?	Same as 4 above	While such a listing would be possible, user should be referred to STIS.
6	What is the current EHS dollar volume of current research on Subject X?	The inquirer might desire a printout of project/contract numbers, project titles, project dates, and dollar amounts	This is a relatively simple request which can be programmed. Slightly more sophisticated programming would be required if the dollar amounts were totaled by the computer at time of printout.
7	What monitoring and surveillance systems with capabilities in Subject Area X are located in Ohio?	No response	This question should be referred to the MSIIS.
8	What monitoring and surveillance systems are located in Ohio, and what is EHS dollar support?	List of M & S systems, location, operator (if other than EHS), supervisor, project numbers, and dollar cost	Would be treated in same way as 7 above.
9	What is the current EHS total dollar commitment in Subject Area X between now and end of fiscal year?		Such programming would be possible. The need should be recognized in early design stages in order to permit future programming.

---

*Scientific and Technical Information System (See page 89).

Yet, it must be recognized that each level of data represented by the questions above represents orders of magnitude in complexity in data acquisition and data storage. EHS can control its data acquisition system internally; the cost involvement as the system is extended externally increases rapidly. The possible need for monetary data further complicates the acquisition problem.

Structure of PIRS Data Base

A proposed informational structure for PIRS is shown in Figure 5. A suggested priority to the order of establishment is given from left to right, while the ease of attainability is shown from top to bottom. The proposed system has the capability of providing historical as well as current information about research projects. However, the major benefit to be derived from the system will be the information supplied about current research projects. Historical information will be of greatest benefit in respect to decisions affecting new project initiations and is more likely to be utilized sporadically and on a nonrecurrent basis. The PIRS system provides a very convenient mechanism for the storage and retrieval of historical information in a compatible form.

Functional organization of PIRS depends upon two main factors – whether the information is current or historical, and whether it is within-EHS- or outside-EHS-generated information. Combinations of the two main factors suggest organization of PIRS to deal with four primary functional areas required for accomplishment of its mission.

Current Information Within EHS.

As previously pointed out, EHS has for some time been in the process of developing a PIRS system. The attempt has been hampered to some extent by the varying reporting requirements of the administrations, and by the inability to apply the manpower required to make such a system operational. Both obstacles must be removed if a viable PIRS is to be created.

At the present time, two different forms are used by ECA and by NAPCA for the reporting of project information. During its tenure as a component of EHS, the FDA used still another form. While these forms contained the elements common to the requirements of a PPBS system and were compatible in the sense that the information they contained could be transferred into a common form, their lack of standardization undoubtedly led to inefficient duplication of effort. The current reorganization taking place within EHS could provide the proper atmosphere in which to institute a change in the administrations' project reporting requirements so that the same form is used throughout EHS.

Current Information Outside EHS.

Many organizations within the Government and within industry are involved in programs of interest to EHS. EHS must be aware of the nature of these programs in order to assure the productivity of its programs in relationship to the efforts of others. Owing to the wide scope of EHS activities and the multitude of other organizations engaged in research of importance to environmental health, it is not practical to routinely input information from all pertinent sources into PIRS.

An alternative approach is to institute a system that would obtain information upon demand as a particular area of interest to EHS is identified. Under this concept, EHS

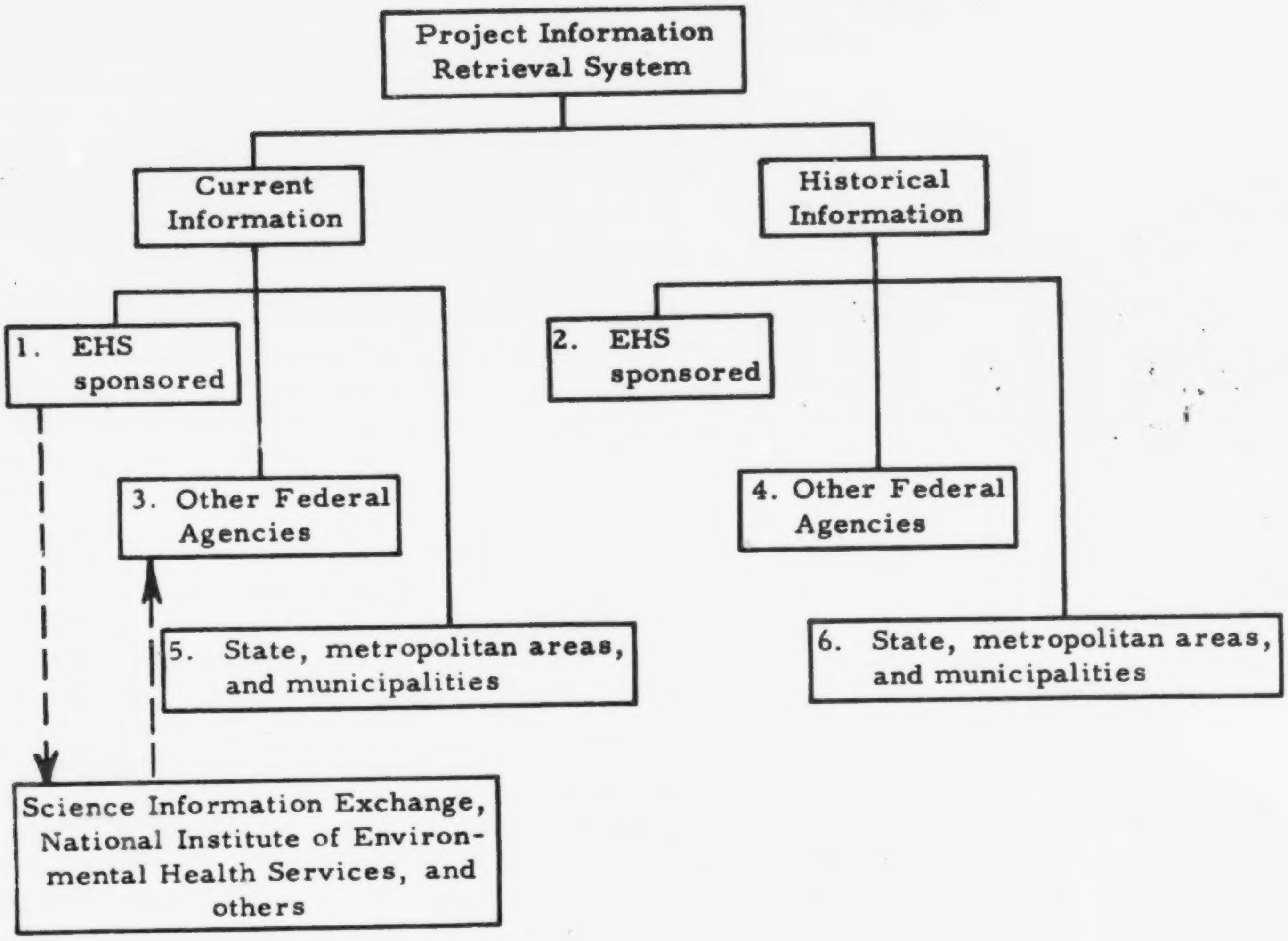

Project Information Retrieval System
Current Information
Historical Information
1. EHS sponsored
2. EHS sponsored
3. Other Federal Agencies
4. Other Federal Agencies
5. State, metropolitan areas, and municipalities
6. State, metropolitan areas, and municipalities
Science Information Exchange, National Institute of Environmental Health Services, and others

FIGURE 5. INFORMATION AND DATA SOURCES FOR PIRS ARRANGED BY RANK ORDER OF IMPORTANCE AND ATTAINABILITY

would establish a working liaison with Federal agencies responsible for, or collecting information on, research projects being conducted that have a scope related to the mission and objectives of EHS. Primary among these organizations are SIE, the NIH, IMPAC System (Information for Management, Planning, Analysis, and Coordination), the DDC Work Unit Information System, and the HUD Clearinghouse Service. At a later date, as the project information system matures, consideration should be given to establishing similar liaison with state and municipal organizations that are conducting significant programs and with trade associations that have achieved prominence in their research programs to solve environmental problems. Information obtained on demand from these various sources would be input into PIRS but suitably coded so that computer searches could readily distinguish between EHS and non-EHS programs. Such programs could also be dropped from the information store upon their completion and need not be utilized for that component of the PIRS system dealing with historical information if they would unnecessarily burden the system.

Historical Information Within EHS. As projects are completed, the information contained in the current research portion of the PIRS file should be transferred to the historical section so that a record is maintained for future reference. Mere transfer of the existing file is inadequate, however, as the current research information file would not include the results of the research. Thus, at the time of transfer, a supplemental record should be appended to the current research information file to summarize the results of the research program and provide identification for the scientific and technical reports that documented the research.

The process described above does not provide for the documentation of research projects that were instituted prior to the establishment of PIRS. Such information should not be lost to the management and operating arms of EHS. Appropriate summaries should be prepared for these concluded programs and integrated into the historical section of the PIRS file. The summaries should be completed in inverse order of the completion date of the research so that the most recent research is summarized first.

Mention was made of the need to provide identification of the scientific and technical reports that documented the completed research. The reports themselves will become a part of the scientific and technical information store. Although the information storage and retrieval system designed for that store will provide a mechanism for retrieval of the report literature, the computer programs and portions of the data base can be utilized to provide input to PIRS. Specifically, to the bibliographic citations for the final reports on EHS projects would be added, the project identification information obtained for the project summaries mentioned above. This arrangement would provide an expanded search capability for PIRS at very little additional cost.

Historical Information Outside EHS. Historical information on projects sponsored by organizations that are not a part of EHS must be obtained on demand as the need arises. The subject scope of EHS is so extensive and the research being conducted in both the Government and private sectors is so large and widespread that it is not practical to collect and store such information on a routine basis.

Internal System Characteristics of PIRS

Referring again to the sample inquiry scenarios given in Table 16, it is apparent that some of these inquiries are susceptible to solution by manual methods. However, some require more sophisticated responses and it appears that expected response-time requirements, particularly those related to budget-planning stresses, are such that a computer storage and retrieval system is indicated as the most desirable course to follow.

The KWIC/KWOC index of projects, while useful as an interim measure, will not have either the flexibility nor the utility required for an operational PIRS. It is suggested that development of the KWOC index be held to a minimum sufficient to meet EHS operational needs. The main thrust by EHS should be toward either the development or selection of a suitable PIRS system based upon the requirements illustrated preliminarily by the scenarios.

There exist in the Government today a number of project information systems utilizing a computer for information storage and retrieval. Notable among these systems are the Science Information Exchange and the Defense Documentation Center's Work Unit Information System. Especially notable is the IMPACT System in the Extramural Program for NIH. Some of these systems have a remote search capability within the boundaries prescribed by constraints placed upon the system design. One of these systems could be adapted to the specific needs of EHS with little technical difficulty, and at considerably lower cost than that for undertaking an independent design project. However, EHS could significantly enhance its search capability by developing an on-line, real-time, remote, interactive system.

The PIRS system as it presently exists within EHS is essentially an index that requires a two-step reference procedure in order to identify the subject detail of a given project of interest. The system adopted by EHS should be structured so that the search response provides all the required information without the need for recourse to another infórmation store.

Although a computer-based system is an essential tool for certain personnel within EHS who must have an up-to-date information store and rapid response capability, there also exists a more casual need that may be satisfied by some form of published material. This published material may be suitable for EHS personnel who need only a reference resource in relationship to their mission accomplishment, or it may be suitable for an annual information disclosure to other agencies - Federal, State, and municipal - and to the public. For this purpose, the computer can be utilized to provide an edited version of the information store used for EHS management purposes.

CENTERS OF TECHNICAL COMPETENCE

Introduction

Increased recognition is being given by the Federal Government to the concept of information analysis centers as an effective means of focusing concentrated research efforts in areas of priority or national importance. As stated by Andrew A. Aines, Chairman of the Committee on Scientific and Technical Information of the Federal Council for Science and Technology:

> "The trend in the United States technical community toward the establishment of Information Analysis Centers has accelerated rapidly. Such centers have become a significant factor in improving the accessibility of reliable scientific and technical information and seem destined to grow rapidly in importance. While the concept of an Information Analysis Center is new, the functions are as old as science and technology, actually being an integral part of the processes by which science and technology have progressed. An Information Analysis Center has been defined as a formally structured organizational unit specifically established for the purpose of acquiring, selecting, storing, retrieving, evaluating, analyzing, and synthesizing a body of information within a clearly defined specialized field, or within a specified mission for the purpose of compiling, digesting, repackaging, or otherwise organizing and presenting pertinent information in a form most authoritative, timely, and useful."(27)

The term "information analysis centers" tends to associate such centers with the information functions and subverts the most important function – that of technical analysis and evaluation. Hence the term "information analysis centers" tends to become synonymous with information centers, libraries, and other efforts having to do with the documentation resulting from science and technology. This should not be the case, however.

This research team believes that the term "Centers of Technical Competence", more clearly represents the concept and, at the same time, results in a clear distinction from the documentation and information centers. Hereafter, in this report this term, or CTC, will be used in place of information analysis center.

The Role of CTC's in Support of EHS

The EHS, as the focal point for concern of all factors which affect man's health through the environment, has a tremendous task in establishing recognition of its role as the authority on man's environment. If it is going to speak with authority, it must have technical competence in the many areas of concern, especially in those areas of high priority or threat. By tapping concentrations of scientists and technologists at various universities and research organizations, which have expertise in areas of environmental threats, for concentrated backup support, the capacity and capability of the EHS family can be augmented and expanded.

Centers of technical competence should not be administered as a part of the information community, but rather as a part of the R&D community. The function which such a center performs is a systematic formalization of the time-honored functions performed by and integral to the R&D community, but directed toward "a clearly defined specialized field, or within a specified mission, of high priority or national importance". The CTC concept, when properly administered as a part of the R&D

effort, is a proven method of focusing technical competence in support of a national effort. This is evident from the number and varied subject areas of such centers now supported by the Federal Government.(28)

Figure 6 illustrates the supportive role of the Centers of Technical Competence both to the EHS Headquarters Element and to the working levels (illustrated as the Bureau in the figure). Assuming that the EHS has established a center of technical competence in response to a threat to the environment of grave national concern, the scientific and technical staff of the center would be available to provide the EHS Headquarters Element with quick response and critical evaluation to meet the pressures of both Congress and the Executive Branch. The staff also would provide state-of-the-art and technical analysis to proper elements within the Bureaus, freeing Bureau personnel for other critical tasks. Further, through the technical guidance of the center's scientific staff, the information staff would acquire specialized technical information and data required to accomplish the mission of the center. Full use would be made of the EHIN facilities in order to avoid duplication. However, as shown by the model case studies, additional information and data will be required for various studies. As illustrated by the information loop in the figure, special acquisitions can feed into EHIN, and this enrichment of EHIN will serve to strengthen EHS resources at all levels.

Guidelines for Centers of Technical Competence

Although Battelle pioneered the concept of "Centers of Technical Competence" or "Information Analysis Centers" in 1951, and the concept was conveyed to the scientific and technical communities in 1963 through the Weinberg Report to the President's Science Advisory Committee(29), it still is not completely understood by many. The following quotation is from the Weinberg report.

> "Specialized information centers, to be truly effective [as a means for transfer of technical information] , must be operated in closest possible contact with the working scientists and engineers in the field. The activities of the most successful centers are an intrinsic part of science and technology. The centers not only disseminate and retrieve information, they create new information. . . . In short, knowledgeable scientific interpreters who can collect relevant data, review a field and distill information in a manner that goes to the heart of a technical situation are more help to the overburdened specialists than is a mere pile of relevant documents. Such knowledgeable scientific middlemen who themselves contribute to science are the backbone of the information center; they make an information center a technical institute rather than a technical library. "

Simpson(30) has pointed out that

> "Researchers who obtain all of their own information through conventional sources are declining in numbers, though many still prefer to follow their own procedures. Because of the increasing demands upon them, more and more scientists and engineers are turning to the IAC's to help supply their information needs. They find that increasingly the Information-Haves are those who have access to such centers. Even experts in rather narrow fields, if they do not

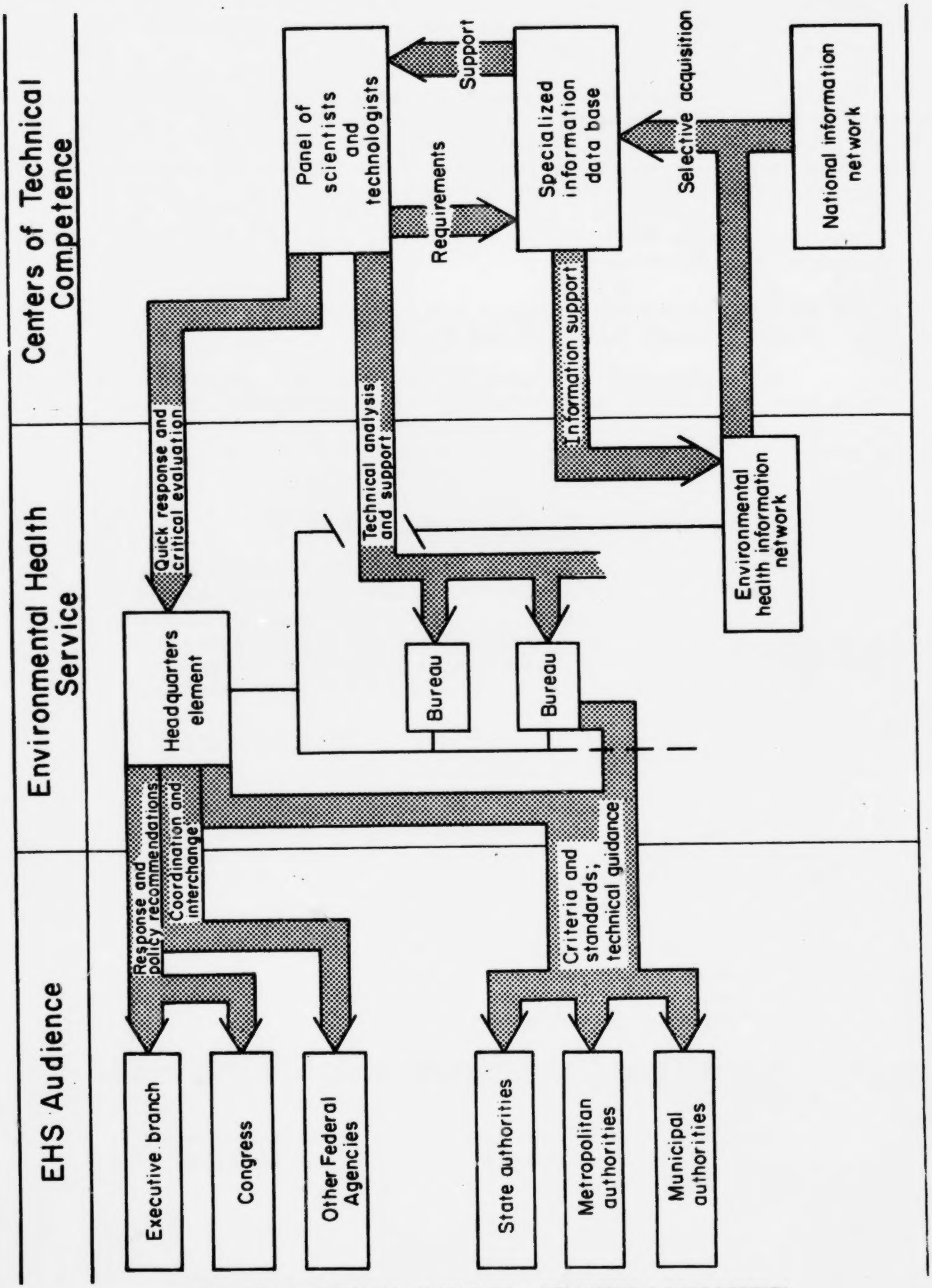

Centers of Technical Competence
Environmental Health Service
EHS Audience
Panel of scientists and technologists
Support
Requirements
Specialized information data base
Selective acquisition
National information network
Quick response and critical evaluation
Technical analysis and support
Information support
Environmental health information network
Headquarters element
Bureau
Bureau
Response and policy recommendations
Coordination and interchange
Criteria and standards; technical guidance
Executive branch
Congress
Other Federal Agencies
State authorities
Metropolitan authorities
Municipal authorities

FIGURE 6. THE SUPPORTIVE ROLE OF THE CENTERS OF TECHNICAL COMPETENCE

have access to IAC's, might at times be classed as Information-Have-Nots because they lack the broad, up-to-the-minute information that can be supplied by such centers."

Appendix D presents a detailed conceptualization of centers of technical competence (information analysis centers). It should be stressed, however, that owing to differences in mission, scope, and discipline areas, no two centers are structured exactly alike. Such centers are designed to accomplish a mission, and one of the tenets of such a center is to adjust to that mission and its requirements.

With the foregoing descriptions as a base, it is possible to examine the guidelines for centers of technical competence.

(a) Centers of technical competence should be established to meet specific areas of concern, usually of high priority.

CTC's are costly; they should not be established just for their own sake, but rather to meet a real area of need or concern. It might be that EHS would decide that pesticides, lead in the atmosphere, or some other area was of sufficient importance to warrant a concentrated study by a group of competent scientists.

(b) The mission of any CTC must be clearly defined.

It follows from (a), above, that the mission of a CTC must be clear and definite to all concerned. It may change with time, and such modifications should be recognized. For example, the mission of a CTC might be to determine the threat of pesticides to humans. Once a full understanding of the threat is reached, the center might shift its talents to seeking ways to reduce the threat.

(c) A center of technical competence should be located at a facility having real knowledge and capability in the area.

A CTC must be located at a university, a research institute, or a laboratory which has a recognized capability in the area of concern. In this way, a concentration of know-how and proven knowledge may be brought to bear upon the problem area by practitioners of the art.

It is useless to establish a center in isolation, requiring practitioners to leave their normal environment to work in an "ivory tower". The practitioners must remain in an atmosphere of creative interchange with their peers.

(d) A CTC should exist only so long as the reason for its establishment remains valid.

Once a library or an information center becomes established, it is generally understood that it will remain to grow and serve. This is not the case with a CTC.

Once a CTC has completed its mission, it should be dissolved or its mission changed. For example, let us assume that it was found that pesticides were harmless to man. There would be no longer a valid mission for a center of technical competence on pesticides. On the other hand, following the example in (b) above, the center's mission should be modified as conditions change in order to achieve the greatest good.

(e) A CTC must remain scientifically or technically oriented.

The function of a CTC is to make available the best "brains" to perform scientific or technical analysis within a problem area. The products of a CTC are state-of-the-art reports, technical compilations, data or design handbooks, and direct answers to technical inquiries.

Bibliographies, literature indexes and abstracts, literature reviews, and similar documentation products are of secondary importance and are considered by-products of a center's operation.

(f) The information/data base of a CTC should be used to enrich the total information flow of the community it serves.

Since a CTC is mission- or problem-oriented, the practitioners (both scientists and technologists) will require specialized information and data necessary to complete their studies and evaluations. The information base of a CTC through acquisition of this information will make a real contribution to EHIN, particularly STIS.

Organization and Operation

In the centers of technical competence at Battelle, it has been possible to develop a method of operation which assures continued technical growth of the associated scientists and technologists and, at the same time, takes full advantage of this growth. This same philosophy may be adapted to other centers of technical competence in varying ways, depending upon the local administrative practices.

Figure 7 represents a generalized organization chart for such a center. Usually, only the manager, the two assistant managers, and the information staff are assigned to the center. The Advisory Council and the scientists and technologists devote only that portion of their time as might be required in view of the tasks and demands that might be placed upon them. The remainder of the time they devote to their normal research and professional activities.

The Advisory Council

The Advisory Council should be composed of one or two senior scientists who have a sound general knowledge in the area of concern and a senior information scientist. From the EHS sponsoring level, for example, whether it be a Division, Bureau, Administration, or Service, one or two program managers can also participate. It is the

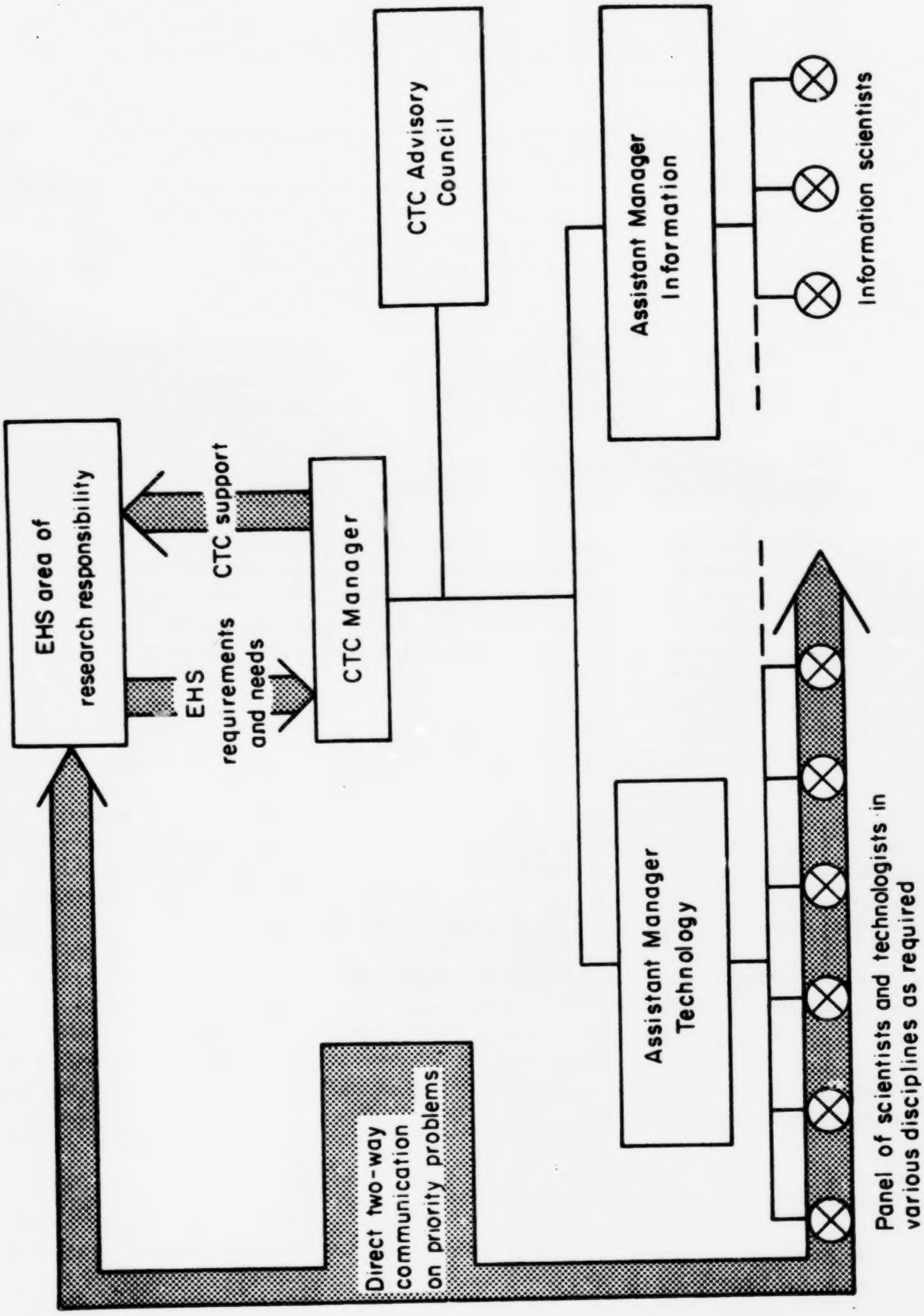

EHS area of research responsibility
EHS requirements and needs
CTC support
CTC Manager
CTC Advisory Council
Assistant Manager Information
Information scientists
Assistant Manager Technology
Panel of scientists and technologists in various disciplines as required
Direct two-way communication on priority problems

FIGURE 7. GENERALIZED ORGANIZATION CHART FOR CENTER OF TECHNICAL COMPETENCE

function of the Advisory Council to review the activities, services, and products of the center in order to assure that they meet the needs of the EHS.

The Panel of Scientists and Technologists

The scientists and technologists are selected in order to represent a well-rounded array of knowledgeable scientists and technologists matching the mission of the center. Since these individuals participate on a "part-time" basis, it is possible to have on call a much greater array of talent than ever would be available if each had to be hired on a full-time basis.

As shown in the organization chart, the scientists and technologists are also available to assist directly the various focal points within EHS. This provides the EHS program managers with a depth of technical support which is normally not available elsewhere.

CTC Coordination

In order to assure maximum utilization of CTC's, a coordinator of such centers should be established at the EHS administrative level. It would be his function to assure proper interchange of methodology and resources within the several CTC's and to assure that overlaps in scope and purpose did not occur. Further, it would be his function to control interfacing of the several centers with other agencies and user groups to assure uniform EHS policy.

Conclusions

On the basis of the review of the tasks facing EHS, the lack of analytical capability within the available information resources, and the necessity to effectively interface between man's knowledge and practice, it appears that centers of technical competence (information analysis centers) would provide an efficient and timely mechanism to supplement EHS expertise. This portion of the study did not attempt to identify orders of priority for the various threat areas and, therefore, specific recommendations have not been developed for areas in which centers of technical competence should be established.

SERVICE-WIDE THESAURUS

At the outset of the study, plans for a Service-wide thesaurus were considered a wise addition to the organization as an aid in compatibility and network control. The Battelle survey of information-facility characteristics requested information on vocabulary-control techniques. Response from the various identified information activities was significant in several respects:

(a) Many activities reported having thesauri or microthesauri.

(b) The definition of thesauri and microthesauri among these organizations was quite varied.

(c) Compatibility of vocabulary-control techniques*, among EHS systems, does not exist at present.

Specific examples of thesaurus-type material gathered during the survey are presented in the following sections.

Air Pollution Technical Information Center (APTIC)

This large-scale information activity has both a thesaurus and a microthesaurus. The microthesaurus was based on the thesaurus, but has gone through independent revision since it was first constructed.

Thesaurus

The thesaurus, developed for APTIC by Science Communications, Inc., (31) in January, 1966, presents index terms with appropriate "broad" terms, including multiple broad terms if deemed necessary. "Related" and "use" terms and scope notes were included, but neither "narrower" terms nor "use for" references (common to most thesauri) were used. Precoordinated terms are liberally used throughout the vocabulary (e.g., pollution measurement methods, odor counteraction, industrial emission sources).

The thesaurus also incorporates the concept of document categories and attributes. Categories include the following:

General Aspects
Emission Sources
Atmospheric Interactions
Pollution Measurement Methods
Control Methods
Effects - Human Health
Effects - Plants and Livestock
Effects - Materials
Economic Effects
Air-Quality Measurements
Legal and Administrative Aspects
Standards and Criteria
Basic Sciences and Technologies
Social Aspects

Categories are defined as characterizations of the major theme and are considered useful for abstract or current-awareness publications. They are essentially a broad classification scheme which is superimposed over the more specific index terms.

Attributes, on the other hand, characterize the type and source of information and include the following:

---

*See Appendix E for thesaurus construction and vocabulary-control techniques developed by the Engineers Joint Council.

Original (Theoretical)
Original (Laboratory)
Original (Field)
Reviews (Technical)
Reviews (General)
Compilations
Bibliographies
Handbooks and Manuals
Directories
Proceedings
Patents

Those for foreign documents include:

Foreign
Country of Origin
Original Language
Translated or Nontranslated.

These attributes are intended to provide greater selectivity in searching.

Microthesaurus

The APTIC personnel were not emphasizing the thesaurus but were relying primarily upon a "microthesaurus" of air-pollution terms, a sample page of which is shown in Figure 8. This microthesaurus was used during the indexing process and was the basis for the original APTIC optical coincidence card system. In the strictest sense, however, this is not a true microthesaurus, but rather an alphabetical listing of approved indexing terms without cross references, scope notes, use references, or other aids. Since the term listing is divided into 15 main categories or classifications, the user must know where to look for a term in order to find it.

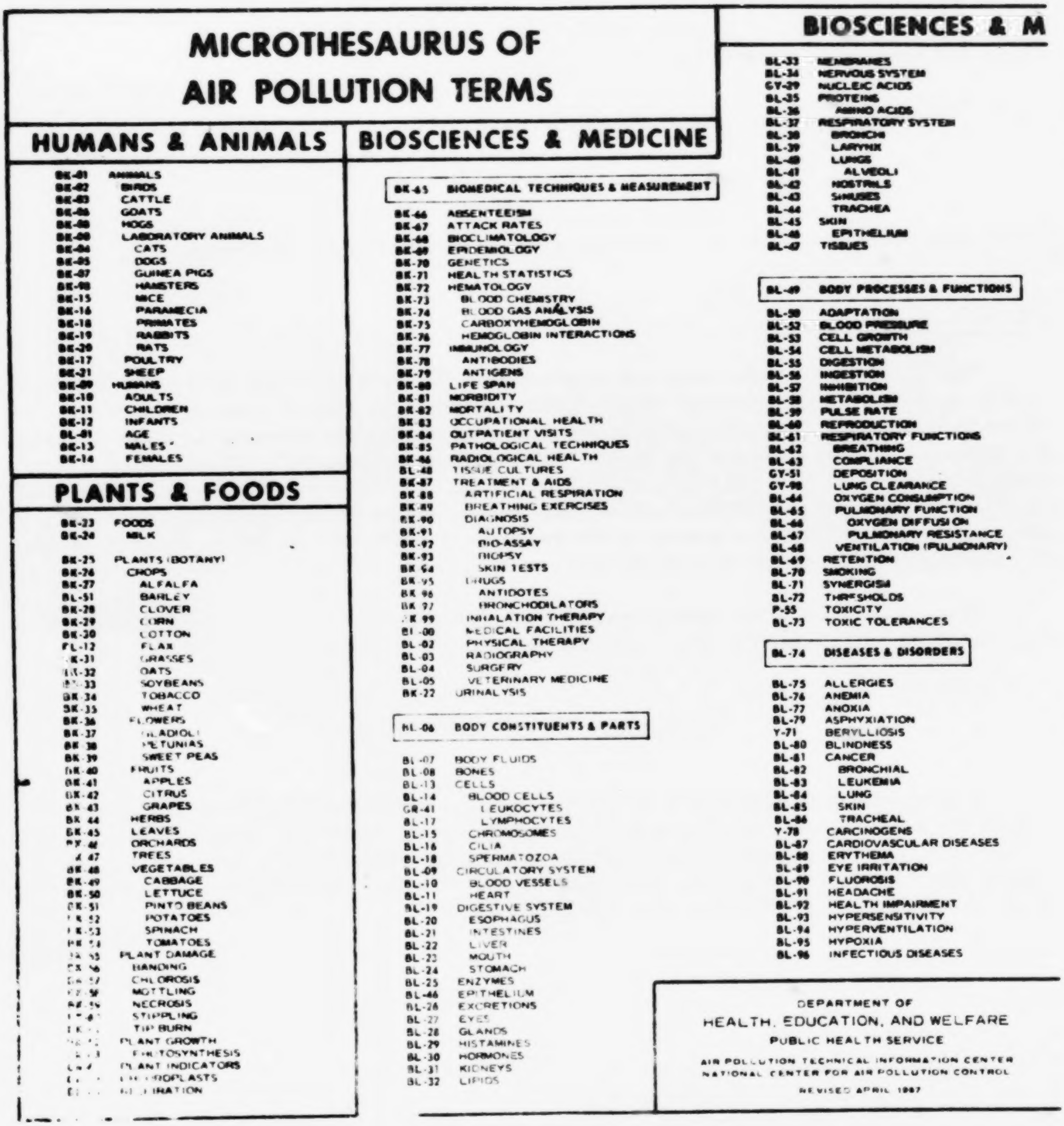
When the APTIC Termatrex system was converted to the Combined File Search System of the EHS Computer Facility, the same microthesaurus was used.

Radioactive Materials Thesaurus

A thesaurus was developed within the Division of Medical Radiation Exposure as part of the Medical and Occupational Radiation Program (MORP). This tool is intended for use with an optical coincidence system and incorporates "use", "see also", "includes" (like a narrower term), "post also", and "use for" references. Ranges of dates, 1895-1899 to 1970-1974, are also included as index terms.

X-Ray Thesaurus

This thesaurus was also developed as part of the MORP activity and is used by the X-ray Exposure Control Laboratory of the Division of Electronic Products, ECA. It is intended for use with an optical coincidence system and incorporates "post also", "use", "use for", "see also", and "includes" references in the same way as the previous thesaurus.



MICROTHESAURUS OF AIR POLLUTION TERMS

HUMANS & ANIMALS

BK-01	ANIMALS
BK-02	BIRDS
BK-03	CATTLE
BK-06	GOATS
BK-08	HOGS
BK-00	LABORATORY ANIMALS
BK-04	CATS
BK-05	DOGS
BK-07	GUINEA PIGS
BK-98	HAMSTERS
BK-15	MICE
BK-16	PARAMECIA
BK-18	PRIMATES
BK-19	RABBITS
BK-20	RATS
BK-17	POULTRY
BK-21	SHEEP
BK-09	HUMANS
BK-10	ADULTS
BK-11	CHILDREN
BK-12	INFANTS
BL-01	AGE
BK-13	MALES
BK-14	FEMALES

PLANTS & FOODS

BK-23	FOODS
BK-24	MILK
BK-25	PLANTS (BOTANY)
BK-26	CROPS
BK-27	ALFALFA
BL-51	BARLEY
BK-28	CLOVER
BK-29	CORN
BK-30	COTTON
FL-12	FLAX
BK-31	GRASSES
BK-32	OATS
BK-33	SOYBEANS
BK-34	TOBACCO
BK-35	WHEAT
BK-36	FLOWERS
BK-37	GLADIOLI
BK-38	PETUNIAS
BK-39	SWEET PEAS
BK-40	FRUITS
BK-41	APPLES
BK-42	CITRUS
BK-43	GRAPES
BK-44	HERBS
BK-45	LEAVES
BK-46	ORCHARDS
BK-47	TREES
BK-48	VEGETABLES
BK-49	CABBAGE
BK-50	LETTUCE
BK-51	PINTO BEANS
BK-52	POTATOES
BK-53	SPINACH
BK-54	TOMATOES
BK-55	PLANT DAMAGE
BK-56	BANDING
BK-57	CHLOROSIS
BK-58	MOTTLING
BK-59	NECROSIS
[illegible]	STIPPLING
[illegible]	TIP BURN
[illegible]	PLANT GROWTH
[illegible]	PHOTOSYNTHESIS
[illegible]	PLANT INDICATORS
[illegible]	CHLOROPLASTS
[illegible]	RESPIRATION

BIOSCIENCES & MEDICINE

BK-65 BIOMEDICAL TECHNIQUES & MEASUREMENT

BK-66	ABSENTEEISM
BK-67	ATTACK RATES
BK-68	BIOCLIMATOLOGY
BK-69	EPIDEMIOLOGY
BK-70	GENETICS
BK-71	HEALTH STATISTICS
BK-72	HEMATOLOGY
BK-73	BLOOD CHEMISTRY
BK-74	BLOOD GAS ANALYSIS
BK-75	CARBOXYHEMOGLOBIN
BK-76	HEMOGLOBIN INTERACTIONS
BK-77	IMMUNOLOGY
BK-78	ANTIBODIES
BK-79	ANTIGENS
BK-80	LIFE SPAN
BK-81	MORBIDITY
BK-82	MORTALITY
BK-83	OCCUPATIONAL HEALTH
BK-84	OUTPATIENT VISITS
BK-85	PATHOLOGICAL TECHNIQUES
BK-86	RADIOLOGICAL HEALTH
BL-48	TISSUE CULTURES
BK-87	TREATMENT & AIDS
BK-88	ARTIFICIAL RESPIRATION
BK-89	BREATHING EXERCISES
BK-90	DIAGNOSIS
BK-91	AUTOPSY
BK-92	BIO-ASSAY
BK-93	BIOPSY
BK-94	SKIN TESTS
BK-95	DRUGS
BK-96	ANTIDOTES
BK-97	BRONCHODILATORS
BK-99	INHALATION THERAPY
BL-00	MEDICAL FACILITIES
BL-02	PHYSICAL THERAPY
BL-03	RADIOGRAPHY
BL-04	SURGERY
BL-05	VETERINARY MEDICINE
BK-22	URINALYSIS

BL-06 BODY CONSTITUENTS & PARTS

BL-07	BODY FLUIDS
BL-08	BONES
BL-13	CELLS
BL-14	BLOOD CELLS
GR-41	LEUKOCYTES
BL-17	LYMPHOCYTES
BL-15	CHROMOSOMES
BL-16	CILIA
BL-18	SPERMATOZOA
BL-09	CIRCULATORY SYSTEM
BL-10	BLOOD VESSELS
BL-11	HEART
BL-19	DIGESTIVE SYSTEM
BL-20	ESOPHAGUS
BL-21	INTESTINES
BL-22	LIVER
BL-23	MOUTH
BL-24	STOMACH
BL-25	ENZYMES
BL-46	EPITHELIUM
BL-26	EXCRETIONS
BL-27	EYES
BL-28	GLANDS
BL-29	HISTAMINES
BL-30	HORMONES
BL-31	KIDNEYS
BL-32	LIPIDS

BIOSCIENCES & M

BL-33	MEMBRANES
BL-34	NERVOUS SYSTEM
GY-29	NUCLEIC ACIDS
BL-35	PROTEINS
BL-36	AMINO ACIDS
BL-37	RESPIRATORY SYSTEM
BL-38	BRONCHI
BL-39	LARYNX
BL-40	LUNGS
BL-41	ALVEOLI
BL-42	NOSTRILS
BL-43	SINUSES
BL-44	TRACHEA
BL-45	SKIN
BL-46	EPITHELIUM
BL-47	TISSUES

BL-49 BODY PROCESSES & FUNCTIONS

BL-50	ADAPTATION
BL-52	BLOOD PRESSURE
BL-53	CELL GROWTH
BL-54	CELL METABOLISM
BL-55	DIGESTION
BL-56	INGESTION
BL-57	INHIBITION
BL-58	METABOLISM
BL-59	PULSE RATE
BL-60	REPRODUCTION
BL-61	RESPIRATORY FUNCTIONS
BL-62	BREATHING
BL-63	COMPLIANCE
GY-51	DEPOSITION
GY-98	LUNG CLEARANCE
BL-64	OXYGEN CONSUMPTION
BL-65	PULMONARY FUNCTION
BL-66	OXYGEN DIFFUSION
BL-67	PULMONARY RESISTANCE
BL-68	VENTILATION (PULMONARY)
BL-69	RETENTION
BL-70	SMOKING
BL-71	SYNERGISM
BL-72	THRESHOLDS
P-55	TOXICITY
BL-73	TOXIC TOLERANCES

BL-74 DISEASES & DISORDERS

BL-75	ALLERGIES
BL-76	ANEMIA
BL-77	ANOXIA
BL-79	ASPHYXIATION
Y-71	BERYLLIOSIS
BL-80	BLINDNESS
BL-81	CANCER
BL-82	BRONCHIAL
BL-83	LEUKEMIA
BL-84	LUNG
BL-85	SKIN
BL-86	TRACHEAL
Y-78	CARCINOGENS
BL-87	CARDIOVASCULAR DISEASES
BL-88	ERYTHEMA
BL-89	EYE IRRITATION
BL-90	FLUOROSIS
BL-91	HEADACHE
BL-92	HEALTH IMPAIRMENT
BL-93	HYPERSENSITIVITY
BL-94	HYPERVENTILATION
BL-95	HYPOXIA
BL-96	INFECTIOUS DISEASES

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
AIR POLLUTION TECHNICAL INFORMATION CENTER
NATIONAL CENTER FOR AIR POLLUTION CONTROL
REVISED APRIL 1967

FIGURE 8. APTIC MICROTHESAURUS - SAMPLE PAGE

Office of Compliance and Standards

The Office of Compliance and Standards in the Bureau of Radiological Health maintains a file of regulations, standards, guides, and legislation on electromagnetic spectrum using an optical coincidence system for retrieval. Key words are presented in a term list arranged by category. The categories are shown in Table 17.

Data Systems and Mathematics Section

This section in the Bureau of Radiological Health is not an information activity in the strictest sense. It performs analysis, design, programming, and operation of data-processing projects. It does have a classification scheme intended for use with an information-distribution program. A portion of this classification is shown in Table 18.

Solid Waste Information Retrieval System (SWIRS)

More accurately called a list of key words, this thesaurus incorporates "use" (but no "use for") references. No other thesaurus devices are used, although words inserted parenthetically as shown in the following example are a form of scope notes or clarification.

Example: IILLUSTRATIONS (schematic designs, pictures, etc.).

The SWIRS operation, located in the Bureau of Solid Waste Management, is currently operated on a card-file basis, using the uniterm concept.

Comparison of Vocabulary Control Techniques Used Within EHS

The matrix of thesaurus attributes shown in Table 19 compares the various approaches used by activities within EHS and also shows their relationship to the Thesaurus Rules and Conventions developed by the Engineers Joint Council (see Appendix E).

Vocabulary-Control Conclusions and Recommendations

The following conclusions are based on the preceding discussion plus information gained from the survey of existing information facilities.

- Multiple, small, special-purpose information systems exist now and will probably persist within the administration of EHS in the future. This is even more probable with the changing structure of EHS activities at the administration and bureau level.

TABLE 17. LIST OF KEY-TERM CATEGORIES FOR OFFICE OF COMPLIANCE AND STANDARDS RETRIEVAL SYSTEM[(a)]

Standard or document classification
Protection, major
International sponsor or foreign country sponsor
National Government sponsor
National association sponsor
Date of adoption
Type of radiation
Radionuclides
Other radiation sources
Population group
Methods
Contemporaneousness
Nomenclature, units, symbols
Calibration standards
Overview elements

(a) Instructions for Storage and Retrieval of Standards and Related Documents, issued by the Standards Service Branch, Office of Criteria and Standards, BRH, ECA, revised July, 1969.

TABLE 18. SAMPLE OF CLASSIFICATION USED BY DATA SYSTEMS AND MATHEMATICS SECTION, BUREAU OF RADIOLOGICAL HEALTH

1.0	Effects of pollution
1.1	Humans
1.2	Animals
1.3	Agriculture
1.4	Materials
2.0	Plants and foods
3.0	Biosciences and medicine
3.1	Diseases
3.2	Human body
3.3	Health
3.4	Allergies
3.5	Respiratory problems
4.0	Materials
4.1	Coal
4.2	Steel
4.3	Metals
5.0	Locations
6.0	Pollutants
6.1	Exhaust emissions
6.2	Fuel evaporation
6.3	Toxicants (fluorine, lead)
6.4	Microorganisms
6.5	Particulates (dust)
6.6	Aerosols
6.7	Gases
7.0	Sources
7.1	Motor Vehicles
7.2	Chemical processes
7.3	Nuclear energy
7.4	Furnaces (incinerators, power)
7.5	Fuels
7.6	Nonindustrial emissions
7.7	Industrial emissions
8.0	Measurement
8.1	Sampling methods
8.2	Analytical methods
8.3	Chromatography
8.4	Particulate classification
8.5	Monitoring
9.0	Control methods
9.1	Equipment
9.2	Air conditioning
9.3	Filtration
9.4	Recovery systems

TABLE 19. COMPARATIVE ANALYSIS OF EHS VOCABULARY-CONTROL TECHNIQUES

	Comparable EJC Thesaurus Techniques[a]					
EHS Facility	Broader Terms (BT)	Narrower Terms (NT)	Related Terms (RT)	Use	Use For	Other
APTIC, NAPCA						
Thesaurus	x	--	x	x	--	--
Microthesaurus[b]	--	--	--	--	--	Classification scheme
Division of Medical Radiation Exposure, Radiation Materials Thesaurus	"post also"	"includes"	"see also"	x	x	--
Division of Electronic Products, X-ray Thesaurus	"post also"	"includes"	"see also"	x	x	--
Office of Compliance and Standards	--	--	--	--	--	Key-term categories
Data Systems and Mathematics Section, BRH	--	--	--	--	--	Classification scheme
Bureau of Solid Waste Management, SWIRS Thesaurus	--	--	--	x	--	--

(a) See Appendix E.

(b) Microthesaurus is the tool relied upon by APTIC.

- System sophistication varies considerably among information activities within EHS, as does staff training in information-handling techniques.
- Current vocabulary-control techniques are not consistent, nor do they conform to what are now considered accepted thesaurus-generation rules.
- Vocabulary-control techniques currently employed by EHS activities appear to serve the needs of the immediate group served by the system.

On the basis of the above conclusions, the EHS information facilities should consider the following recommendations:

(a) Allow a maximum of flexibility in structuring a thesaurus to each system currently in use or under development. Growth of new special-purpose information systems should not be stifled by creating a unified vocabulary at this stage of development. This is especially true for an organization as flexible as EHS.

(b) Enforce accepted thesaurus-building rules across the board at the EHS level. This will initiate establishment of a compatibility of the various thesauri in terms of cross-reference techniques and similar devices. Efforts should also be made to instruct the various information activities on the general differences and applications for thesauri as opposed to alphabetical or hierarchical lists of clue words. This type of groundwork is essential if effective interchange of information between the various information systems is to occur.

COMPUTER STATUS

General

When the Battelle team began its study, the Division of Data Processing within the Office of Administration of CPEHS was responsible for the development and performance of data-processing systems and the management and operation of the computer facilities serving the CPE Headquarters and the three Administrations.(32)

Each Administration remaining in EHS also had data-processing facilities. A tabular summary of computer facilities within each Administration and at the service level is shown in Table 20.

TABLE 20. TABULATION OF COMPUTER FACILITIES SERVING EHS OPERATIONS

Responsible Agency	Computer	Location
Central facility	IBM 360/50	Washington, D. C.
NAPCA	GE 225	Independent contractor, Raleigh, N. C.
NAPCA	IBM 1130	Durham, N. C.
ECA	Honeywell 400	Cincinnati, Ohio
ECA	IBM 1130	Cincinnati, Ohio
ECA	IBM 1620	Rockville, Md.

Central Facility

The central facility performed a variety of tasks as represented by the listing included in Figure 9. It was operated by FDA personnel, partially funded by NAPCA money, and under CPEHS administration. With the removal of FDA from CPEHS, the fate of this facility remained uncertain. The latest indication was that the programming personnel would be returned to the FDA, other personnel would remain with EHS, and the facility itself would be a joint-services activity under HEW.

The central computer facility located in Washington was originally intended to service the member administrations by means of IBM 360/20 units at each facility connected to the central unit IBM 360/50 in Washington. The main problem with this configuration as seen by the Administrations was that they would have very little stand-alone computational capability and would have to rely on the central unit and be subject to its priority scheduling as well as their own priorities.

The data-processing unit in Washington does offer a storage and retrieval system for information(33) that was designed specifically for it by The Service Bureau Corporation and which is currently used by APTIC as well as various FDA information systems. This software package, the Combined File Search System, is written in assembly language for the IBM System/360 and is designed to hold about 500,000 documents. The programs are run in a batch mode and provide narrative text as an output of a search statement.

Administration Facilities

Highly detailed descriptions of the data-processing requirements for each administration were prepared by a task force from each Administration for submission to EHS.(34, 35) These task-force reports provided a detailed breakdown of the current and projected needs of each Administration in the area of automatic data processing.

P&C/ADP OP BRANCH/DDP/AAA/CPE/PHS/DHEW

DIRECTORY OF AUTOMATED JOBS

OCTOBER 1, 1969

CODE	TITLE	NAME
XXYY00	WORK FOR AN ORGANIZATION PRIOR TO SPECIFIC JOB ASSIGNMENT	FEASIBLE
XXYY50	REQUESTS RELATED TO SUPPOSEDLY NON-RECURRING PROJECTS WHERE 999 EQUALS THE NUMBER OF THE SPECIAL REQUEST	SPEC999
XXYY99	EXECUTIVE, LEGISLATIVE OR DEPARTMENTAL WORKLOAD WHERE 999 EQUALS THE NUMBER OF THE PRIORITY REQUEST WHERE XX EQUALS THE BUREAU, ETC. AND YY EQUALS THE DIVISION, ETC.	PRTY999

• •

CODE	TITLE	NAME
010001	DISTRICT OFFICE DATA PROCESSING - DISTRICTS	DODDIST
020103	STATUS OF ALLOTMENT - CURRENT YEAR	STATCAIC
020104	STATUS OF ALLOTMENT - PRIOR YEARS	STATCAIP
020202	PERSONAL PROPERTY INVENTORY - EAM	PPIEAM
020203	FDA LOCATOR	LOCATOR
020401	PROMOTION APPRAISAL	PROMAPPR
020403	SELECTIVE FDA PERSONNEL INFORMATION	FDAPERS
020404	MONTHLY MINORITY GROUP EMPLOYMENT CENSUS	MINORITY
040001	FDA FIVE YEAR PLAN	FDAPAFPS
040002	ANALYSIS OF ANTIBIOTICS POST - CERTIFICATION	NTIB%
040101	FDA OFFICIAL ESTABLISHMENT INVENTORY	PUDSUEI
060101	COMPUTER USAGE FOR TRAINING BY SIF PERSONNEL	SIFTRAIN
060106	NATIONAL DRUG CODE DIRECTORY	NDCD
060107	DRUG EFFICACY - SIF	DRUGEFFI
060108	DESI-B	DESIB
060109	CLINICAL ABSTRACTS PRINTING - TEXT 360*	TEXT 360
060110	DERWENT SERVICES	DERWENT
060111	KEYWORD IN/OUT OF CONTEXT INDEXES - K	KWICK
060112	KEYWORD IN/OUT OF CONTEXT INDEXES - M	KWICM
060113	ICR SEARCH	ICRSR
060201	FDA LIBRARY - BILLING SYSTEM	LIBRARY
060301	CAS SUBSTRUCTURE SEARCH SYSTEM	ACSCAS
060302	CHEMICAL ABSTRACTS CONDENSATES	CASCUND
060303	FDA CENTRAL RETRIEVAL INDEX	FDCRI
060501	SYNONYM TAPE ENRICHMENT	SYNONYM
060502	SCIENCE INFORMATION VETERINARY INTERIM SYSTEM	SIVIS
070001	STATISTICAL ANALYSES ROUTINES	STATANAL
070402	ANALYSIS OF NUCLEAR MAGNETIC RESONANCE SPECTRA	NMRSW&RE
070403	ANALYSIS OF NUCLEAR MAGNETIC RESONANCE SPECTRA	NMRHARIS
070404	ANALYSIS OF HIGH RESOLUTION NMR SPECTRA	LOACN3
070405	NUCLEAR MAGNETIC RESONANCE LITERATURE RETRIEVAL PROGRAM	NMRLIT01
070406	ANALYSIS OF NMR SPECTRA WITH ITERATION	NMRHAR2
070407	DAUGHTER ION MASSES	MASSES
070601	MIN-DO MAC DATA SYSTEM	MAC
071001	PESTICIDE AND FOOD ADDITIVE PETITIONS CONTROL - EAM	SCIEAM
071002	PHARMACOLOGY/ANIMAL EXPERIMENTATION	PHARMEXP
080001	INDEX OF NEW VETERINARY DRUG APPLICATION	BVMINDEX
080002	VETERINARY INVESTIGATIONAL DRUG INDEX SYSTEM	VIDIS
080003	BVM DOCUMENT STATUS REPORT	BVMSTATO
080005	STUDY OF LEAST SQUARE ANALYSIS OF VARIANCE PROGRAM	LSQUARES
080101	DRUG EXPERIENCE HISTORY	BVMDRHST
090101	PESTICIDE REPORTING FY 64	PESTFY64
090102	PESTICIDE REPORTING FY 65	PESTFY65
090103	PESTICIDE REPORTING FY 66	PESTFY66
090104	PESTICIDE REPORTING FY 67	PESTFY67

FIGURE 9. REPRESENTATIVE LISTING FROM CENTRAL FACILITY DIRECTORY OF AUTOMATED JOBS

Each Administration concluded that its present facilities were inadequate, and that to depend on a computer facility located in Washington would not be satisfactory. Both ECA and NAPCA requested stand-alone computer facilities to perform their missions.

NAPCA ADP Task Force Summary

The survey conducted by the NAPCA Task Force was intended to:

- Provide background on the NAPCA ADP situation
- Clearly depict the current ADP workload within NAPCA
- Project the role of ADP and associated resources in relation to the specific objectives and overall mission of NAPCA
- Set down the recommendations of the Task Force.

The NAPCA computer workload was surveyed by the Task Force and equivalent run times were calculated for IBM 360 systems in order to project the workload for the CPE system. The workload is summarized in Table 21. The Task Force indicated that with this workload plus developmental work in progress, a system of the 360/40 range could be justified immediately for NAPCA.

TABLE 21. CURRENT COMPUTER USAGE BY NAPCA CONVERTED FOR VARIOUS REPLACEMENT COMPUTERS

Present Computer	Actual Current Usage, hr/month	Equivalent Converted Usage for Replacement Computer, hr/month		
		360/30	360/40	360/50
IBM-1130	289.1	531.9	185.0	69.4
GE-225	27.0	12.7	11.3	11.1
H-400	222.5	222.5	89.0	62.1
IBM 360/50	83.0	386.0	174.3	83.0
Totals	621.6	1,153.1	459.6	225.8

Source: Automatic Data Processing Task Force Report, National Air Pollution Control Administration, November 17, 1969.

The Task Force report included a detailed discussion of ADP needs and uses by each division within each bureau. Specific information is contained on pages 10 to 41 of that report.

The Task Force drew general conclusions and specific recommendations from its study. General conclusions included:

- Air pollution scientists have had to adjust analysis techniques to inadequate data-processing situations.

- NAPCA requires a stand-alone computer capability to be most effective.

- The stand-alone requirement is justified on the basis of not only workload requirements but also a number of unquantifiable considerations.

- To keep conversion delay to a minimum, a remote terminal connected to the CPE 360/50 should be installed as soon as possible so conversion can begin before a stand-alone facility is required.

The specific recommendations of the Task Force were:

- A remote terminal processor with card and tape I/0, card punch, and high-speed printer should be installed very soon.

- The stand-alone computer-capability concept should be adopted by the NAPCA Technical Center. A single unit capable of teleprocessing and computing is advised.

- The necessary decision should be made by the end of 1969.

ECA ADP Task Force Survey

The ECA survey provided details of individual activity needs, evaluation of ECA mission and programs from an ADP perspective, and an overview including specific conclusions and recommendations.

Each ADP application within an ECA organization was documented and specific data were collected on file size, activity of file, program language, computer, etc. Specific details are contained in Section 3 of the ECA Task Force report.

Unlike NAPCA, ECA has a broad range of environmental problems to cope with, and must move in several directions at the same time, including such areas as:

- Home injuries
- Solid waste
- Occupational injuries
- Drinking-water quality
- Noise pollution
- Housing sanitation
- Radiation exposure.

According to the Task Force, this wide range of problem areas, plus a limited budget, required that ECA make use of all time- and labor-saving devices available. ECA already has made considerable use of the computer in its various programs.

An estimate of future computer workload and a summary of past workload developed by the ECA Task Force is presented in Figure 10, which represents the past and

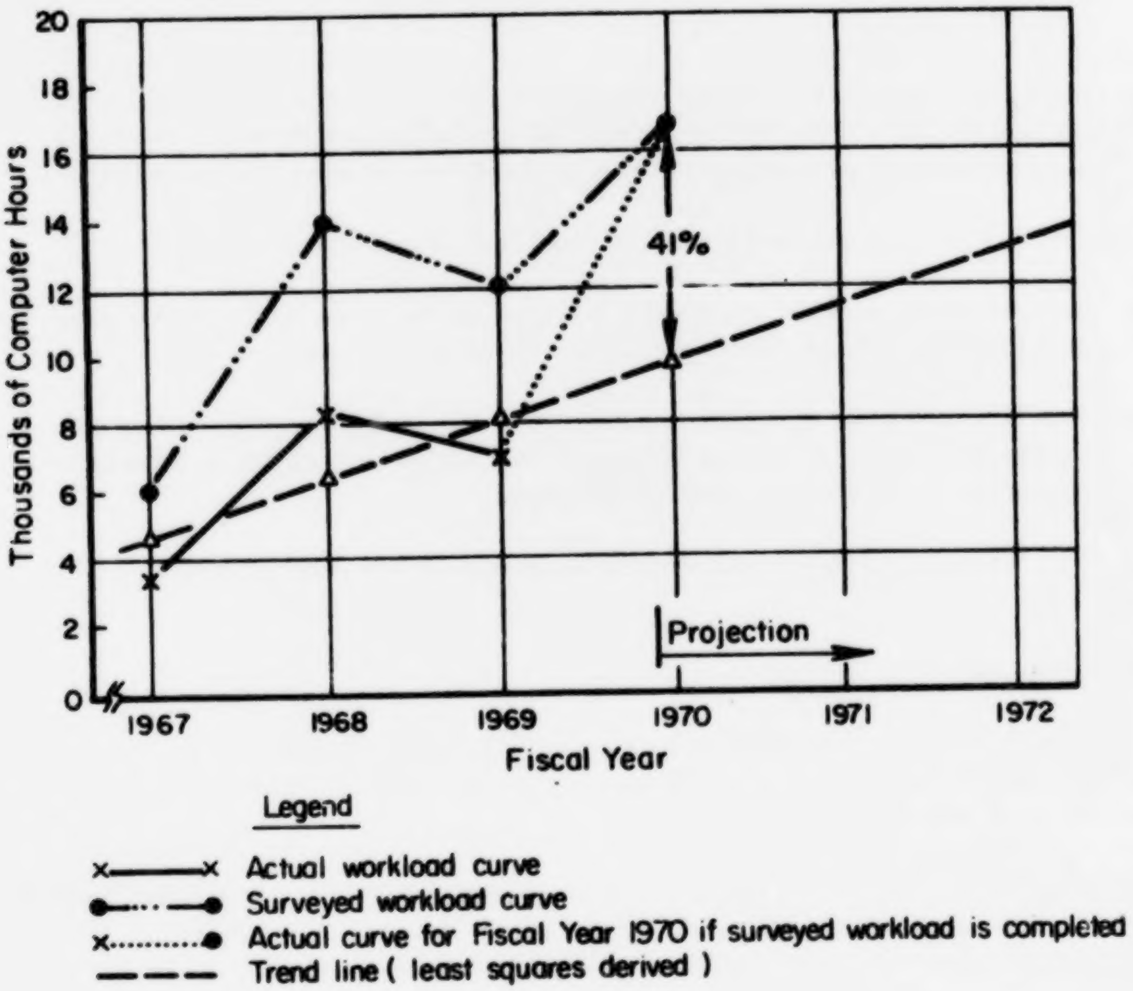


FIGURE 10. ECA COMPUTER WORKLOAD ADJUSTED TO AN IBM 360/30

Area between actual and surveyed workload curves represents work theoretically not done. If trend line is used to project Fiscal Year 1970 actual workload, 41 percent of surveyed workload will not be done.

Source: Report of the Task Force on A-PP Requirements, Environmental Control Administration, November 17, 1969.

projected running time for the computers used by the ECA. The running times have all been adjusted to a standardized computer assumed to be an IBM 360/30.

Conclusions of the Task Force included:

- The reorganization of July, 1968, left ECA with a variety of functional and organization problems in relation to ADP.
- Computer manpower is not used the same way in each of the two ECA facilities (Rockville, Maryland, and Cincinnati, Ohio).
- In-house ADP equipment is becoming obsolete and costly and, in addition, the variety of noncompatible equipment increases cost.
- Computer workload could be judged and allocated to a large scale (CPE) or smaller scale (ECA) computer facility to determine overall needs.

The Task Force then made the following recommendations:

- That there be established in the Office of the Commissioner, ECA, a unified data-processing organization, by combining under the central leadership of a Chief of Technical Systems the computer staffs located in Rockville and Cincinnati.
- That the Rockville and Cincinnati computer staffs be supported to the level necessary to effectively service the needs of ECA. Additional positions: Rockville 3, Cincinnati 4.
- That this report be accepted as the basis for a justification for acquiring new equipment for the Rockville and Cincinnati facilities.
- That certain applications indicated in this report be transferred to the CPE facility for processing, since these applications are of such size and complex scope that they require processing capacity beyond that of the level of equipment being considered for ECA sites.

Conclusions and Recommendations for EHS Computer Facilities

The overall computer-facility requirements within NAPCA and the various bureaus which comprise ECA, while outside the realm of this study, have a bearing on the computer requirements for the proposed EHIN. If the load placed on the central computer facility by NAPCA and the bureaus is heavy, the available time for service-level operations will be jeopardized. Field interviews indicated that the various levels of management acknowledged the value of a centralized computer facility in terms of cost savings, but considered the loss of control over priorities to be a significant factor affecting any final decision. Various facilities probably can justify, and should have, a stand-alone computer capability in addition to access to the central computer facility, primarily for data-processing and research purposes. However, with regard to information systems, every effort should be made to strive for compatibility of operations.

As far as EHS administrative computer requirements are concerned, it is unlikely that a computer configuration larger than the one now available within the central computer facility (IBM 360/50) would be required. However, EHS may face the same problem identified by its components – that of priorities. Because of the uncertain fate of the old CPEHS computer facility, it is difficult to predict exactly what will be available to EHS in the future. While it would be extremely difficult to justify a computer specifically for EHS administrative requirements, it is equally clear that EHS must have access to a computer facility capable of running such program packages as the Combined File Search System.* The computer facility provided for EHS administrative operations, including information storage and retrieval operations, should equal, or exceed the capability of the equipment employed currently in the central computer facility, if that facility cannot be made available to EHS.

In addition, a system capable of supporting several remote terminals for access by EHS management personnel would be desirable in the future. This would require a careful evaluation of the existing centralized computer facility in conjunction with the software to be implemented in order to determine the necessary core storage requirements for the system. Another alternative for this future requirement would be to use one of the commercially available time-shared systems for information storage and retrieval in order to provide management with an on-line search capability.

THE CONCEPT OF INFORMATION NETWORKS

Over the past 5 years, increased national recognition has been given to the concept of information networks. However, real progress in the establishment of operating networks has neither been particularly rapid nor clean cut. Before attempting to develop an information network for the EHS, it is desirable to examine the concept itself.

Perhaps the most flexible definition of an information network was developed by Becker and Olson(5) as follows:

> "In an information network, more than two participants are engaged in a common pattern of information exchange through communications for some functional purpose. . . "

In some instances, the functional purposes of information exchange may be quite general. For example, for years libraries have operated a very loosely constructed information network for the exchange of journals and books (interlibrary loans) and for the centralized storage of older and less used materials (archival storage).

However, in modern context, the functional purposes of information exchange are becoming more and more specialized. An example is the information system network being established by the Office of Education, the Educational Resources Information Center (ERIC). Even more highly specialized networks are being established or planned, one of which would be for the Environmental Health Service.

---

*Requirements for that system, as an example, include:

System/360 with 64K of core storage and DOS
Console typewriter, card reader, and line printer (132 positions)
Five magnetic tape drives
Five 2311 disk drives
One 2521 data cell drive.

Source: "Operating Instructions for an Information Storage and Retrieval System", prepared for Consumer Protection Environmental Health Service by The Service Bureau Corporation, July, 1968.

Two principal types of information networks appear to be evolving:

(a) Banding together of various types of information resources (e.g., libraries, information systems, referral centers) into some type of communications cooperative.

(b) A network of computerized information centers, presumably interconnected to permit machine-machine interfaces. It is generally assumed that man will interface with the computers through remote real-time access terminals.

Within these two broad categories, there may be multiple subsets designed to meet specialized requirements. For example, information networks may be identified as a combination of class of equipment, form of data, and function, examples of which are shown in Table 22. It is easy to visualize a form of information transfer network based upon almost any combination shown in the table.

The problem is one of choosing the best configuration or combination of configurations dependent upon the requirements to be placed upon the network, the benefits to be gained, and their cost effectiveness. The premature selection of both class of equipment and form of data can result in costly revisions and modifications at later dates. This has occurred all too often in the early design of information systems: the system was designed to fit the available hardware and later expensive modifications became necessary to meet user requirements.

The ideal characteristics for an information network, as presented in Becker and Olson's paper, provide a much more flexible basis for consideration of the networks. These are shown in Table 23.

The aspects of network organization warrant more detailed consideration. Figure 11 presents three basic alternative types of organization for information networks. The simplest of these is the monolith. The monolith is a highly centralized information system that draws together into one system those functions that might otherwise be performed by a number of individual systems. For its designated sphere of cognizance, the monolith acquires all of the required information, processes it into a unified store, receives and responds to all inquiries, and provides all the needed products and services for the entire user population.

The free, unorganized network permits individual systems to develop whenever and wherever they are needed. To the extent that interaction or cooperation between the diverse systems is required to properly service an inquiry or to provide other products or services, the operators of each of the individual systems must establish and maintain such channels of interaction as they see fit.

The concept of the coordinated network also permits individual systems to develop wherever needed. However, in this case, a central coordinating organization is superimposed on the population of individual systems such that the lines of interaction are markedly simplified as shown in Figure 11(c). For example, suppose an inquiry were

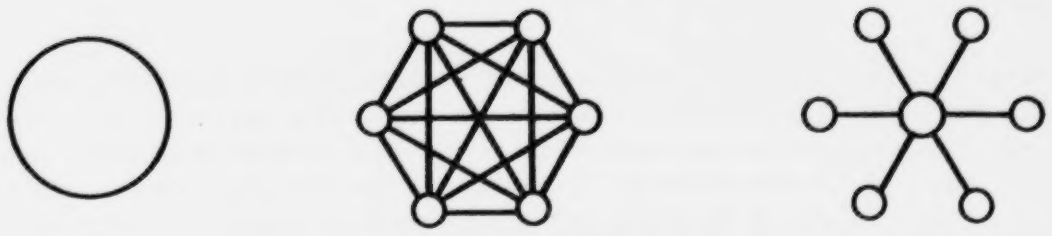
TABLE 22. IDENTIFICATION OF INFORMATION NETWORKS

Class of Equipment	Form of Data	Function
Telephone network	Digital network	Financial networks
Teletype network	Audio network	Library networks
Facsimile network	Video network	Biomedical information networks
Computer network	Film network	Educational networks
Etc.	Etc.	Agricultural networks
		Management networks
		Etc.

Source: Adapted from J. Becker and W. C. Olson, "Information Networks", Annu. Rev. Inform. Sci. Technol., 3, 289-327 (1968).

TABLE 23. GENERAL CHARACTERISTICS OF INFORMATION NETWORKS

Characteristics	Prescription
Formal organization	The combining of many sources through overall administrative control
Communications	Creation of circuits to connect geographically distant sources rapidly
Bidirectional operation	Provision for two-way flow of information between points in the network so that a user may also function as a source
Directory and switching capability	The capability to identify and access the best source(s) to satisfy a particular request

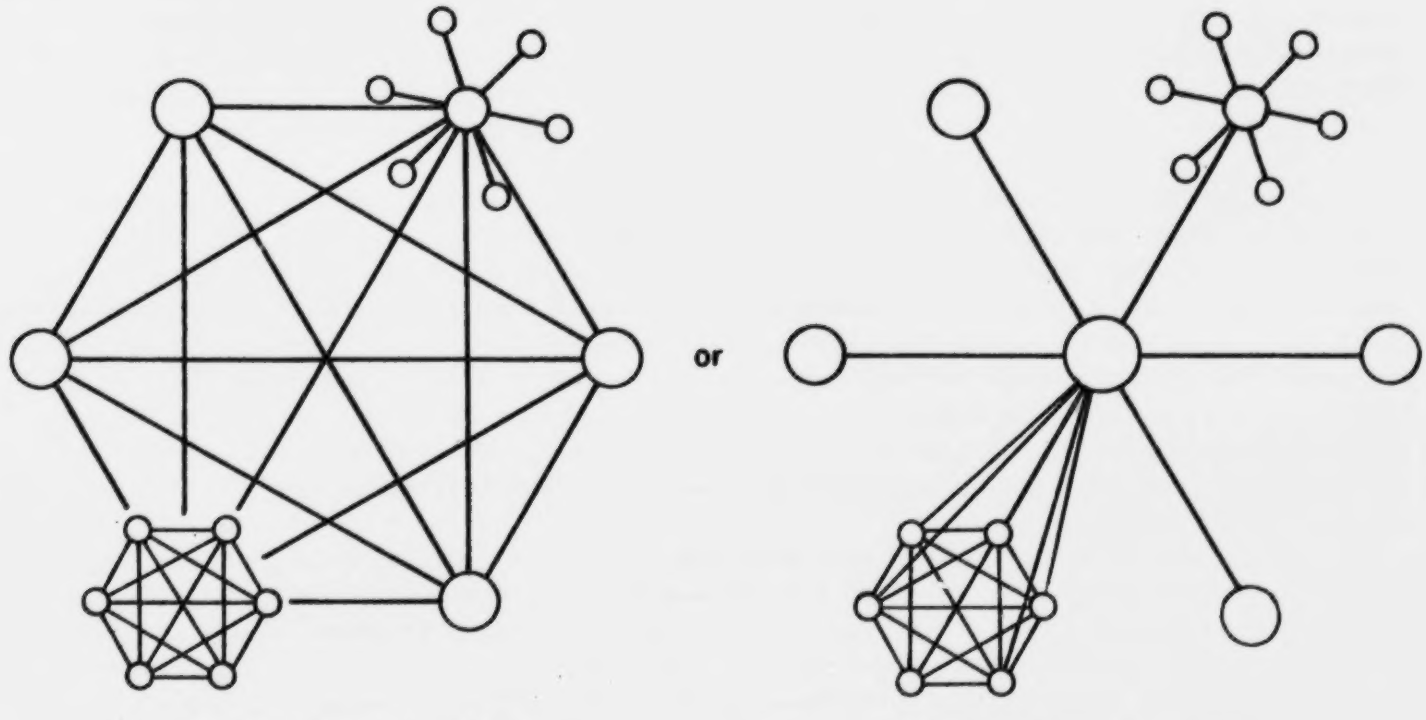


a. Monolith

b. Free-Unorganized Network

c. Coordinated Network

ALTERNATIVE



d. Free-Unorganized Network

e. Coordinated Network

AGGLOMERATED

FIGURE 11. NETWORK ORGANIZATIONS

directed to one of the systems in the network, but that a comprehensive response to the inquiry would require inputs from a number of the individual systems. In the coordinated network, the centralized coordinating body would assume the task of acquiring the coordinating multiple inputs and making them available to the one system that must answer the inquiry.

This characterization of the coordinating network provides the basis for understanding the concepts of the referral system and the switching system. In a referral network, the inquiry addressed to any individual system is referred to other additional systems that can contribute to the answer. This requires the inquirer to establish direct contact with those systems to which he is referred in order to obtain their inputs toward answering the inquiry. The switching network goes a step further in providing service to the inquirer. Having received an inquiry, the switching network establishes contact with all of the appropriate associated systems, acquires their inputs to the answer to the inquiry, consolidates these inputs and presents to the inquirer a comprehensive coordinated response to his inquiry. In the case of either the referral network or the switching network it is the centralized coordinating body that provides the inter-system cooperation required. These concepts are highly related to the basic information and data distribution patterns discussed in an article by Stanley Applebaum of Lever Data Processing Services, Inc.(36)

As an illustration, the series of three organizational models of Figure 11 might be applied to information-handling functions of a corporation. A corporation could consider building a monolithic information system, "the corporate information system". What is more likely to happen is that a corporation will allow each department (such as manufacturing, finance, accounting, personnel, sales) to devise and construct its own information-handling facilities as it sees fit. If this is the case, the corporate information system may become either a free unorganized network or a coordinated network (involving a centralized corporate information referral or switching group).

The same organizational models can be applied, for example, at the national level. The Soviet Union chose to implement the monolithic VINITI, the centralized Soviet national system for handling scientific and technical information. A brief look at the overall information-handling situation in the United States would show the "national system" to be a free unorganized network in which a proliferation of individual systems of various sizes, types, and subject areas have been permitted to grow and interact on an almost totally uncontrolled basis. The influence applied so far by the United States Government has been in the direction of achieving a coordinated national network of information systems rather than moving toward a monolithic structure.

The two examples above illustrates that the three organizational models can be applied to information situations at almost any level of generality or specificity. It is important to realize further that any single satellite system in either the free unorganized network model or the coordinated network model could itself be organized according to anyone of the three models (a monolith, a free unorganized network, or a coordinated network) as illustrated in Figure 11. Thus, these three organizational models can form a variety of combinations to represent the total complex of organizational relationships in all types of networks from the very simple to the very complex.

THE ENVIRONMENTAL HEALTH INFORMATION NETWORK (EHIN)

Theoretical Versus Realistic Network

In developing a network from existing information centers and services, a compromise has to be made between the theoretically envisioned network and what realistically can be achieved. This compromise is necessary because the nodes of the network are often well-established and deeply rooted activities. To force them into a theoretically conceived network with all the associated characteristics could create havoc. The primary goal of a realistic network effort should be to change a loose confederation of systems and sources into a more formal structure that will be of greater utility than the sum of its parts.

As a guide to the real-world network structure there is a set of ideal characteristics for which to strive. These include formal organization, rapid communications capability, bidirectional operations (compatibility, two-way communications, etc.), and directory and switching capability.

Specifically in terms of the EHS situation, it is necessary to determine what portion of the ideal characteristics can realistically be achieved.

Formal Organization

Organizationally, EHS information resources are deeply enmeshed in their respective administrations and should remain so. A small organization could be instituted at the EHS level, however, to act as an information cosmopolitan and liaison between these and other outside sources and the EHS management. The recognition and use of existing sources by EHS management in their decision-making process will do more to formalize the network than will any theoretical plan.

Rapid Communications Capability

There are several ways of providing rapid communication links between information sources/users. The telephone provides many of the required qualities: speed, interaction, freedom of use, and natural language; the telephone in conjunction with facsimile transmission also provides for transfer of hard copy from one point to another within a network on a rapid basis. A computer network could also be used to develop a portion of the information network. However, total dependence on a computerized data base and peripheral computers or communication terminals is not realistic in developing the total EHS information network. Many of the present systems are not of the size or nature to be computerized. Others have grown to the point where they may now justify computerization. The network must provide for inputs from the entire range of systems.

Bidirectional Operations

The structure of the network must be such that each information node can receive and transmit to every other node. Source and recipient must be interchangeable so that information can flow up and down the various organizational levels as well as across divisional, bureau, and administration levels. This is accomplished through knowledge of sources and resources of each group, encouragement of interbureau cooperation by administrative-level personnel, and opening channels of communication by means of conferences and seminars, for example. On an operational level, compatibility of procedures and formats would increase ease of information interchange as would a unified indexing vocabulary across the various information activities. Study has shown, however, that the variety and depth of existing microthesauri within EHS preclude creation of a usable Service-wide thesaurus. Compatibility of storage formats can be established through the expanded use of the batch Combined File Search System implemented by the group at the EHS level and used by such organizations as APTIC.

Directory and Switching Capability

A directory system enabling an individual to identify the appropriate resources for his request and a switching or referral mechanism to route his request over the optimum path are the final requirements of a theoretically complete network. It is this facet that merited early completion, and the research team has identified most of the relevant resources. The resulting "Directory of Information Sources for the Environmental Health Service" can be used by EHS-Level personnel to obtain information for administrative decision making and also could be used by technical personnel at the laboratory level.

Network Components

It is proposed that the diversified information, data, monitoring and surveillance, and management systems be formed into a coordinated information network similar to Figure 11(e) to be known as the Environmental Health Information Network or "EHIN". The component structures of EHIN would be

- Information Resource Identification System (IRIS)
- Scientific and Technical Information Systems (STIS)
- Monitoring, Surveillance, and Intelligence Information System (MSIIS)
- Project Information Retrieval System (PIRS).

Organization

The proposed structure of EHIN is shown in Figure 12.

- The policy-making body of EHIN would consist of a Director and an Advisory Council made up of representatives from the various operating levels, and from STIS, MSIIS, and PIRS.

- Attached to the Director's Office should be a small section charged with maintaining a current inventory of all information, data, monitoring, and surveillance activities within EHIN. This group would be entitled the Information Resource Identification System or IRIS.

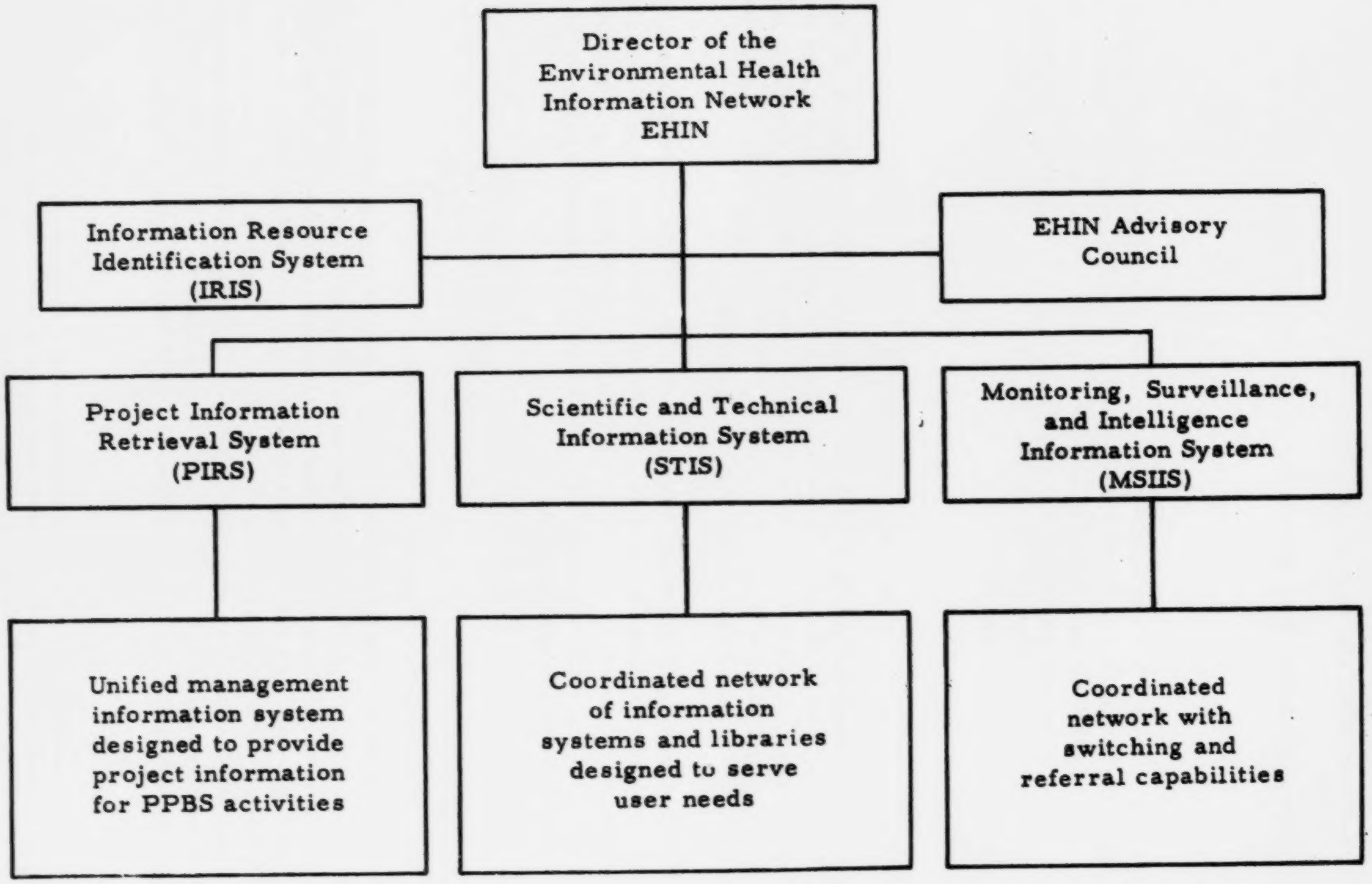

Director of the
Environmental Health
Information Network
EHIN
Information Resource
Identification System
(IRIS)
EHIN Advisory
Council
Project Information
Retrieval System
(PIRS)
Scientific and Technical
Information System
(STIS)
Monitoring, Surveillance,
and Intelligence
Information System
(MSIIS)
Unified management
information system
designed to provide
project information
for PPBS activities
Coordinated network
of information
systems and libraries
designed tu serve
user needs
Coordinated
network with
switching and
referral capabilities

FIGURE 12. GENERAL CONCEPTUALIZATION OF ENVIRONMENTAL HEALTH INFORMATION NETWORK

- PIRS should be a centralized management information tool possibly, but not necessarily, located within the EHS Headquarters Element.
- STIS and MSIIS should each be a coordinated network of systems and facilities, each located and operating with its user group.

Each component of the network is discussed in the following paragraphs.

Director of EHIN

Within the Headquarters Element of EHS, a Director of EHIN should be appointed to represent and coordinate the interests of the network, not only at the EHS level, but, more importantly, in interagency and other Federal activities. For example, he should represent EHIN on the Committee on Scientific and Technical Information (COSATI) which operates under the Federal Council for Science and Technology in the Office of Science and Technology of the President(37).

EHIN Advisory Council

The Director should be assisted by a selection of five members of the EHS staff representing PIRS, MSIIS, and STIS, plus three ex officio members. Five members would be selected on a rotating basis from the operating levels – that is from the actual information and monitoring and surveillance activities. The three ex officio members would be the coordinating managers of PIRS, STIS, and MSIIS.

Council's functions would be those of representing the various activities within their respective areas, and advising the Director of EHIN. The Council would assure the vitality of the network, determine its requirements for equipment (e.g., computers, and other hardware/software), and recommend establishment, consolidation, or disestablishment of activities within the network.

Information Resource Identification System (IRIS)

IRIS should be a relatively small operation (e.g., one technical information specialist and two supporting clerks) maintaining an inventory of information resources and providing switching and referral service* both for the use of the entire staff and for referral of other agencies desiring information or data to the proper portion of the EHIN network. While the network may eventually stabilize, the value of such an operation was demonstrated by the rapidity with which the various surveys of EHS information resources have become outdated. IRIS should also interface with the National Referral Center to augment its specialized resources with the broader coverage afforded by NRC.

---

*Referral is the process that involves directing inquirers to the most probable source of appropriate response to an inquiry for information or data. The service may include directing inquirers to individuals as well as to organizations. Switching is the process that involves routing an inquiry for information or data from the organization receiving it directly to a source of appropriate response.

IRIS should release an annual compilation of EHS information, data, and monitoring and surveillance activities in addition to providing continuing switching and referral services.

Project Information Retrieval System (PIRS)

PIRS should be a centralized system, operating within the Headquarters Element or at a designated location within one of the Administrations. The initial minimum staff should consist of one technical information specialist and one systems analyst plus supporting clerical staff. Further increases in staff will depend upon the work area encompassed by the center as described in the detailed analysis for PIRS presented earlier in this report. The research team recommends that the establishment of PIRS be given high priority, utilizing the software already developed for similar activities within other branches of the Federal Government.

Monitoring, Surveillance, and Intelligence Information System (MSIIS) and Scientific and Technical Information System (STIS)

The Monitoring, Surveillance, and Intelligence Information System and the Scientific and Technical Information System would each remain a federation of centers. Each center or activity should report to the highest authority (unit, section, branch, division, bureau, or administration), consistent with its mission, scope, and user audience. Organization of the centers and activities should, in general, follow the coordinated network structure shown in Figure 11(e).

Compatibility of methodology should be sought wherever possible consistent with mission, scope, and cost benefits. Here, caution must be exercised. A relatively small, highly specialized library should not be forced to use an expensive computer-based storage and retrieval system. Normal library systems (the card catalog) may be just as effective. On the other hand, one of the small compliance and control centers, or a small monitoring and surveillance activity faced with data-reduction problems, may be highly justified in its utilization of elaborate computer systems.

Particularly within STIS, compatible thesaurus development must be encouraged. The accepted and most advanced methodology should be used by all activities developing thesauri. This does not mean that all centers must use the same thesaurus. The literature on radiological health requires a quite different vocabulary than does the area of solid-waste management.

Effective use must be made of the current state of the art in building both information and data systems. The various functional levels should not attempt to develop new systems, parallel to those already developed, until such time as they are current with, or require, capabilities not yet within the current state of the art.

The Role of EHIN

The importance of a viable Environmental Health Information Network is evident from Figure 13. It becomes the pathway for the total flow of information and data, not only to EHS, but beyond - to the Congress and to the public.

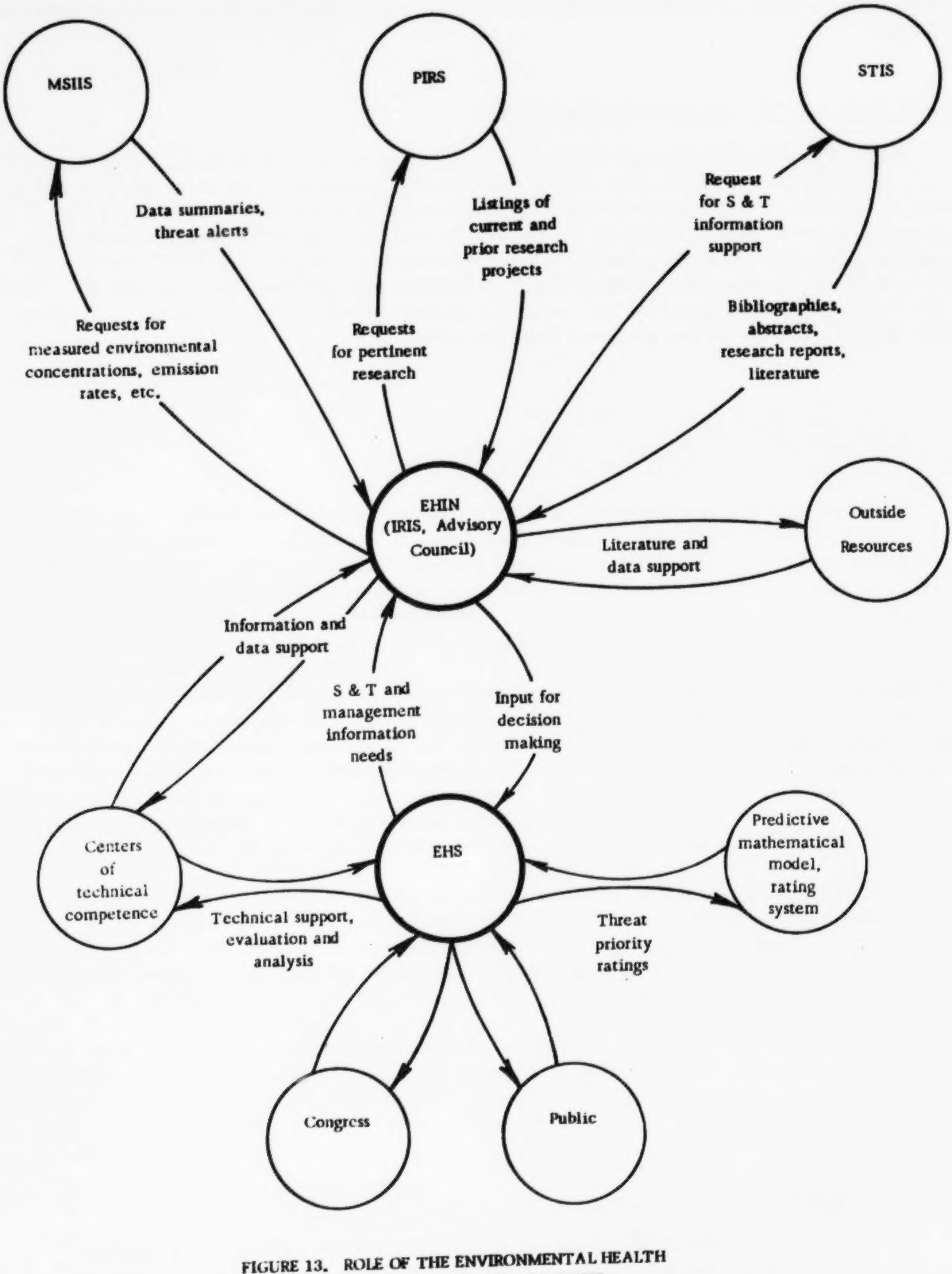

MSIIS
PIRS
STIS
Data summaries, threat alerts
Listings of current and prior research projects
Request for S & T information support
Requests for measured environmental concentrations, emission rates, etc.
Requests for pertinent research
Bibliographies, abstracts, research reports, literature
EHIN (IRIS, Advisory Council)
Outside Resources
Literature and data support
Information and data support
S & T and management information needs
Input for decision making
Centers of technical competence
EHS
Predictive mathematical model, rating system
Technical support, evaluation and analysis
Threat priority ratings
Congress
Public

FIGURE 13. ROLE OF THE ENVIRONMENTAL HEALTH INFORMATION NETWORK (EHIN)

It should be stressed, however, that EHIN, as such, is not a capping organization through which all requests must flow. Rather, it is a coordinated network which must assure that the total, direct assistance of all resources is brought to bear upon any environmental problem of importance to the well-being of man in his environment.

The concept illustrated in Figure 13 further stresses the importance of the centers of technical competence, the predictive mathematical model, and the rating system. The predictive mathematical models and the rating system are described in detail in other volumes of this report, not as components of the information system, but rather as both research and management tools.

The total network structure of EHIN is represented in Figure 14. This diagram illustrates the relationships within EHS as well as various external resources. The total size of the component of this network external to EHS and the information support it can provide to EHS are enormous. By utilizing the network principle, EHS can benefit from the investments being made by other agencies of the Federal Government in their individual information facilities, thus multiplying manyfold the investment made by EHS.

One note of caution must be observed, however. As illustrated by the model case studies, it does not follow that all information and data required by EHS for case studies, the rating system, or in stressor evaluation will be found within this network, nor can the information requirements be totally anticipated and fed into EHIN.

By developing network ties and providing intercenter communication, however, much can be accomplished to relieve the burden of information and data exploitation.

EHIN as a Threat-Evaluation Tool

Figure 15 illustrates the manner in which the various components of EHIN would assist during a critical period of threat evaluation from the time of preliminary identification of a threat through determination of the rating value to be assigned the threat. The events depicted are not intended to represent a fixed pattern or model but may vary as dictated by the nature of the threat and its potential harm. In some instances, portions of EHIN may not be able to respond (e.g., the proper constituents may not be monitored by MSIIS). In other instances, political pressures could override all rating factors. Utilization of EHIN should remain flexible in order to provide the most efficient and timely responses possible, both to the EHS Headquarters Element and to the working echelons of EHS.

Further, it should be noted that the sequence of events depicted in Figure 15 are not intended to replace the "Overview System" previously designed for the Office of Environmental Health since the "Overview System" was intended to provide earlier and less identifiable alerts than are visualized here.(38)

In utilizing EHIN for threat evaluation, the following sequence of events may occur:

1-3, 6-7. The EHS Headquarters Element may request the proper Bureau or Office to prepare a "quick" threat evaluation.

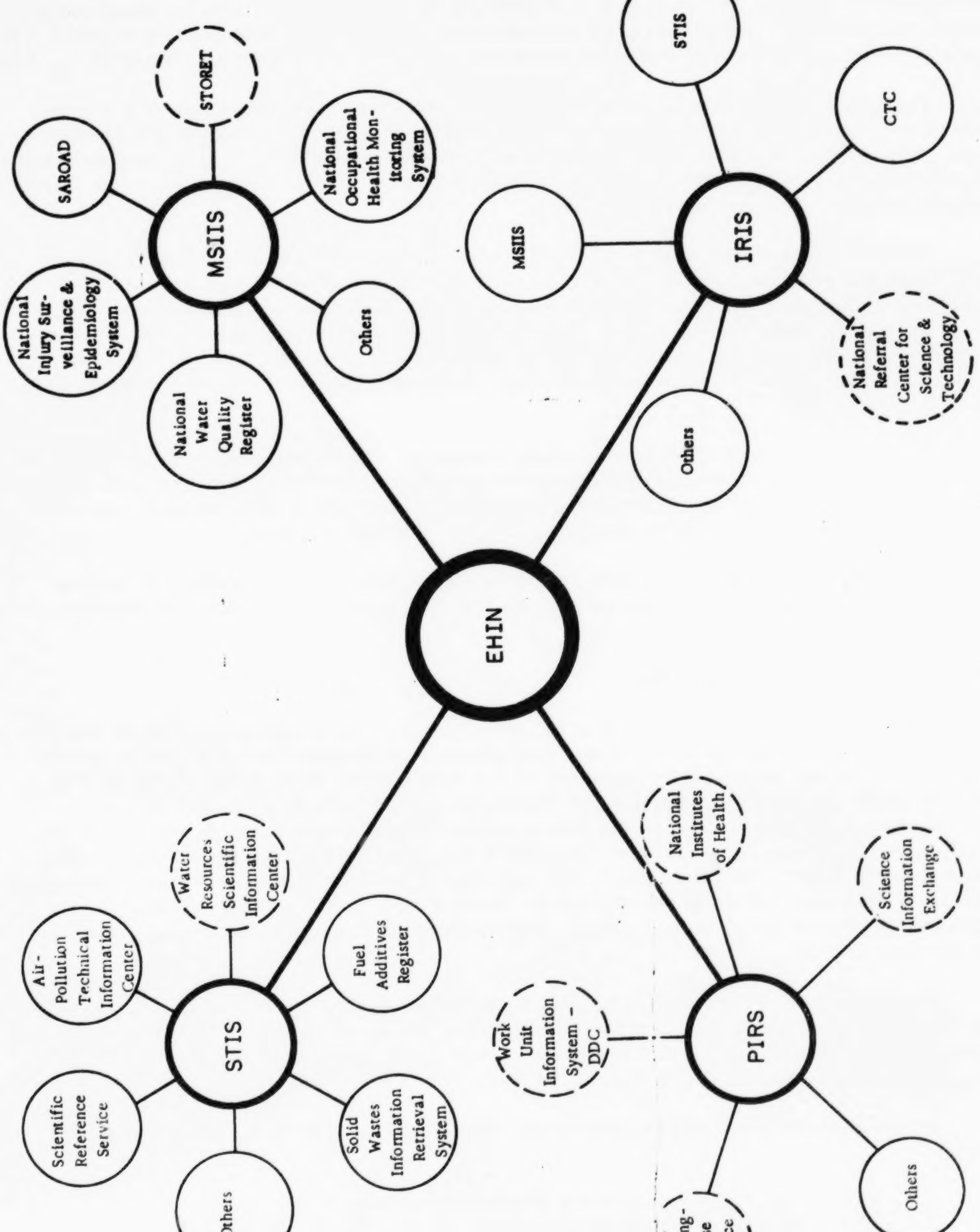

EHIN
MSIIS
SAROAD
STORET
National Occupational Health Monitoring System
National Injury Surveillance & Epidemiology System
National Water Quality Register
Others
IRIS
STIS
CTC
MSIIS
National Referral Center for Science & Technology
Others
STIS
Air-Pollution Technical Information Center
Water Resources Scientific Information Center
Fuel Additives Register
Scientific Reference Service
Others
Solid Wastes Information Retrieval System
PIRS
National Institutes of Health
Science Information Exchange
Work Unit Information System - DDC
Clearing-House Service
Others

FIGURE 14. THE ENVIRONMENTAL HEALTH INFORMATION NETWORK SHOWN IN THE AGGLOMERATED, COORDINATED CONFIGURATION

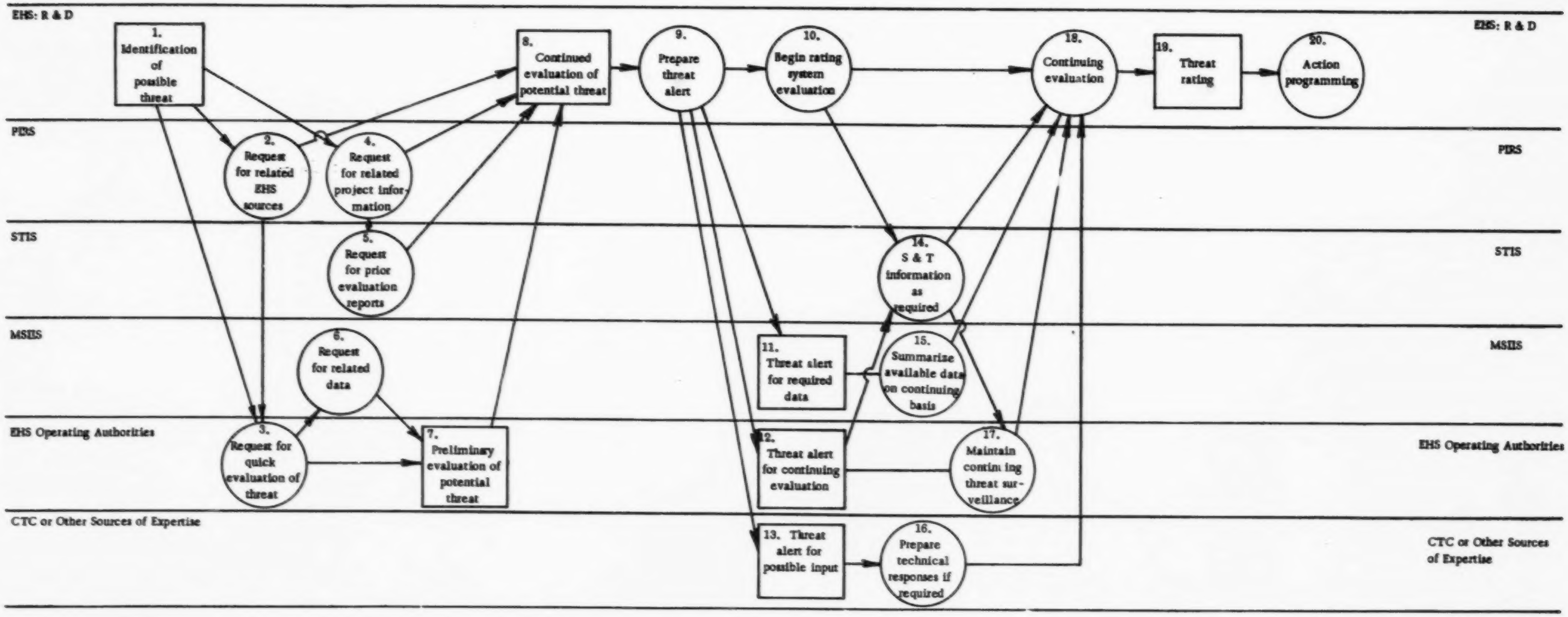

EHS: R & D
PIRS
STIS
MSIIS
EHS Operating Authorities
CTC or Other Sources of Expertise
1. Identification of possible threat
2. Request for related EHS sources
3. Request for quick evaluation of threat
4. Request for related project information
5. Request for prior evaluation reports
6. Request for related data
7. Preliminary evaluation of potential threat
8. Continued evaluation of potential threat
9. Prepare threat alert
10. Begin rating system evaluation
11. Threat alert for required data
12. Threat alert for continuing evaluation
13. Threat alert for possible input
14. S & T information as required
15. Summarize available data on continuing basis
16. Prepare technical responses if required
17. Maintain continuing threat surveillance
18. Continuing evaluation
19. Threat rating
20. Action programming
EHS: R & D
PIRS
STIS
MSIIS
EHS Operating Authorities
CTC or Other Sources of Expertise

FIGURE 15. POSSIBLE ROLE OF EHIN DURING THREAT EVALUATION

BLANK PAGE

4. At the same time, EHS would request PIRS for information on any past or present work within EHS jurisdiction or by other agencies.

5. Simultaneously, or after (2) above, EHS would request prior research or evaluation reports from the STIS network.

8. Upon receipt of the various responses, further evaluation of the possible threat can be made.

9. Threat alert.

10. EHS would begin to evaluate and rate the threat in terms of the predictive mathematical model and rating system.

11-12. All related operating functions within the Service can be alerted to provide continuing surveillance and intelligence.

13. Related centers of technical competence or other authorities within industry, academia, or Federal agencies should be contacted for input.

18-19. The final evaluation of the threat, leading to PPBS activities, can then be made.

By concerted effort of the network, all levels of EHS should be better able to evaluate threats. By utilizing the entire network in a similar manner, all levels of EHS can have the proper information and support to move against such threats once they are identified.

IMPLEMENTATION OF EHIN

The information and data requirements of EHS are complex and not completely defined. Further complicating the EHS requirements are the many and varied interfaces of EHS with other organizations such as FWQA, FDA, NIH, the Department of Agriculture, and others concerned with man's environment. Discussions, recommendations, and legislative bills further becloud the future. However, from this study, it seems clear that EHS should move expeditiously toward the establishment of EHIN. To use a trite phrase, EHS should "get its own house in order".

The activities which appear to represent the greatest need are those primarily encompassed by PIRS. These include:

a. Inventory all current and past internal projects

b. Inventory all current and past external contracts and grants

c. Inventory all results (reports) produced to date both internally and by contract and grant

d. **Organize the above in such a manner as to make them both accessible and useful to the entire EHS community including EHS management, EHS operational levels, and EHS contractors.**

Each of the above activities, while expressed in simplistic terms, represents a difficult task. The accomplishment of activity (d) is directly involved with the implementation of PIRS.

The first steps, then, are to institute an EHS-wide inventory of past and current projects and the results obtained, as contained in the various project reports. So far as it was possible to determine during the course of this project, no such file of information currently exists in a single location. The required information will have to be elicited from a multiplicity of locations, through the cooperation of individual bureau chiefs and office managers.

In conjunction with the above activity, a library of all EHS-produced reports should be established and a requirement should be levied that all future projects send at least one copy of each report to this central facility.

Structuring of an environmental thesaurus oriented to the need of EHS should be started. It is strongly urged that the thesaurus be based upon actual content of projects and reports (and eventually S&T literature) rather than be constructed by a conference of experts. While the latter is possible, it is both expensive and may result in generalized decisions which may or may not be of practical value in actual practice. Further, it is almost certain that many vocabulary terms of real value to the user S&T community will be missed by such a conference and will need to be integrated at later stages.

The "Directory of Information Sources for the Environmental Health Service" will almost certainly not be current at the time of its release to the user community. This points up another high-priority area with EHIN. IRIS, the referral and switching arm of EHIN, should be established as quickly as possible. It initially should be based upon EHS facilities, including information, data, and monitoring and surveillance functions. IRIS, in its early stages, may be no more than a file of descriptions similar to those contained in the Directory. However, as IRIS is developed, more sophisticated methods will be required.

STIS and MSIIS, both of which are already implemented to some degree within EHS, will evolve naturally. However, in order to assure controlled growth of both networks, and at the same time evaluate continued functioning of existing components, they should be brought under review of EHIN management at an early date.

It is recognized that the implementation of the network structure will not be simple, nor will it be accomplished within a short span of time. Because of the complex nature of not only the EHS information requirement but also the entire environmental community, no attempts have been made to estimate costs. Rather, the investigating team has sought to structure a flexible, comprehensive network that will permit EHS to take advantage of investments made by other non-EHS components in their information resources. The Environmental Health Information Network will provide the EHS Headquarters Element and the administrative staff with a versatile supportive tool and at the same time be responsive to the needs of the working levels of the Service.

REFERENCES

(1) U. S. Govt. Organization Manual 1969-70, p. 339. Office of the Federal Register, National Archives and Records Service, General Services Administration, Revised July 1, 1969.

(2) *Government's Environment Offices Proliferate*, CPR National Journal, January 31, 1970, pp 208-209.

(3) "Survey of Technical Information Systems in the Consumer Protection and Environmental Health Service", prepared by the Division of Management Systems, Assistant Administrator for Administration, CPEHS, PHS, DHEW, November, 1968.

(4) Office of Science and Technology Review of CPEHS Information Programs, March 7, 1969, Washington, D. C., unpublished material.

(5) Becker, J., and W. C. Olson, "Information Networks", *Annual Review of Information Science and Technology*, *Volume 3*, 1968, Carlos A. Cuadra, Editor, pp 289-327.

(6) *Development of an Engineered Plan for a United Engineering Information System, Volume II – Appendix,* report by Battelle Memorial Institute to the Tripartite Committee under National Science Foundation grant, July 21, 1969, pp AA-1 to AA-42.

(7) *Engineering Information/Data Environment*, Battelle Memorial Institute internal working document used in Tripartite Study, undated.

(8) Fried, J., et al., *Design Specifications for a Computerized Information Analysis Center Capability*, Battelle Memorial Institute, April 30, 1969, Appendix A, pp 1-23.

(9) Berul, L., *Information Storage and Retrieval – A State-of-the-Art Report*, Auerbach Corporation, September 14, 1964, pp 4-1 to 5-12.

(10) *Newsletter of the Special Interest Group on Library Automation and Networks*, Vol. 1, No. 6, October 1967, American Documentation Institute.

(11) *Nonconventional Scientific and Technical Information Systems in Current Use*, Questionnaire issued by Herner and Company under National Science Foundation contract, 1966.

(12) *Study of Scientific and Technical Data Activities in the United States – Volume II – Preliminary Census of Scientific and Technical Data Activities, Part C*, Science Communication, Inc., April 30, 1968.

(13) Carter, L. F., et al., *Recommendations for National Document Handling Systems in Science and Technology, Appendix A, Volume I – A Background Study*, System Development Corporation, September, 1965.

(14) 1970-75 Program Financial Plan & Operating Plan of the National Air Pollution Control Administration; FY years 1970 & 1971; CPEHS Tactical Plan Series; Consumer Protection and Environmental Health Service; Department of Health, Education, and Welfare.

(15) 1970-75 Program Financial Plan & Operating Plan of the Environmental Control Administration; FY years 1970 & 1971; CPEHS Tactical Plan Series; Consumer Protection and Environmental Health Service; Public Health Service; Department of Health, Education, and Welfare.

(16) 1970-75 Program Financial Plan & Operating Plan of the Food & Drug Administration; FY years 1970 & 1971; CPEHS Tactical Plan Series; Consumer Protection and Environmental Health Service; Public Health Service; Department of Health, Education, and Welfare.

(17) Management Plan of the Office of the Administrator; FY years 1970 & 1971; CPEHS Tactical Plan Series; Consumer Protection and Environmental Health Service; Public Health Service; Department of Health, Education, and Welfare.

(18) Thesaurus of Engineering and Scientific Terms, Engineers Joint Council, NYC, First Edition (December, 1967).

(19) "Air Pollution Control Active Research Grants for Fiscal Year 1969", U. S. Department of Health, Education, and Welfare, Public Health Service, Consumer Protection and Environmental Health Service, National Air Pollution Control Administration, October, 1969.

(20) "Water Resources Research Catalog", U. S. Department of the Interior, Office of Water Resources Research, Water Resources Scientific Information Center, Washington, D. C., December, 1968 (GPO).

(21) Federal Environmental Quality Monitoring and Surveillance Activities, Federal Council for Science and Technology, Committee on Environmental Quality, Subcommittee on Monitoring and Surveillance, November 4, 1968 (Unpublished).

(22) Personal communication with J. R. Fensterstock, Acting Chief, National Inventory of Air Pollutant Emissions and Control Branch, March 18, 1970.

(23) Fair, D. H., Morgan, G. B., and Zimmer, C. E., Storage and Retrieval of Air Quality Data, System Description and Data Coding Manual, Environmental Health Series - Air Pollution, NAPCA, June, 1968.

(24) Rowe, S. M., National Aerometric Data System, Air Quality Section, Status Report, Division of Air Quality and Emission Data, NAPCA, August 26, 1969.

(25) Letter to Commissioners and Associate Commissioners of NAPCA, FDA, and ECA from Charles C. Johnson, Jr., dated August 3, 1969.

(26) Internal CPEHS Memorandum titled "Project (Work Unit) Reporting System", attached to above letter, no date.

(27) Aines, A. A., Introduction to "The Information Analysis Center, Seven Background Papers", Committee on Scientific and Technical Information, Federal Council for Science and Technology, October, 1969, COSATI 69-6.

(28) Directory of Federally Supported Information Analysis Centers, Committee on Scientific and Technical Information, Federal Council for Science and Technology, January, 1970. Available from Clearinghouse for Federal Scientific and Technical Information, PB 189300.

(29) "Science, Government, and Information", A Report of the President's Science Advisory Committee, The White House, January 10, 1963, 52 pp. Available from G.P.O., $.25.

(30) Simpson, G. S., Jr., "The Evolving U. S. National Scientific and Technical Information System", Battelle Technical Review, 17 (5,6), 21-28 (May-June 1968).

(31) Searle, V. C., Farris, B. K., and Myatt, D. O., Thesaurus of Air Pollution Terms, developed for U. S. Public Health Service by Science Communications, Inc., January, 1966.

(32) Management Plan, Fiscal Years 1970 and 1971, of the Office of the Administrator, U. S. Dept. of Health, Education, and Welfare, PHS, CPEHS, (For Official Use Only), p 102.

(33) Program Manual for An Information Storage and Retrieval System prepared for Consumer Protection and Environmental Health Service by the Service Bureau Corporation, July 1968.

(34) Report of the Task Force on ADP Requirements, Environmental Control Administration, November 17, 1969.

(35) Automatic Data Processing Task Force Report, National Air Pollution Control Administration, November 17, 1969.

(36) Applebaum, S., "What Does it Take to Go On-Line", Computer Decisions, pp 20-24 (January, 1970).

(37) Recommendations for National Document Handling Systems in Science & Technology, System Development Corporation, Santa Monica, California, AD-624560, Vol. II, pp 10-29, 10-31, 10-49, and 10-51 (September, 1965).

(38) Lutz, G. S., et al., "Design of an Overview System for Evaluating the Public Health Hazards of Chemicals in the Environment: Vol II, The Overview System", Battelle Memorial Institute, July 18, 1967, PH-86-66-165.

DLM/jvd

APPENDIX A

SURVEY QUESTIONNAIRE FOR CATALOG OF INFORMATION FACILITY CHARACTERISTICS FOR A CONSUMER PROTECTION AND ENVIRONMENTAL HEALTH INFORMATION NETWORK

APPENDIX A

SURVEY QUESTIONNAIRE FOR CATALOG OF INFORMATION FACILITY CHARACTERISTICS FOR A CONSUMER PROTECTION AND ENVIRONMENTAL HEALTH INFORMATION NETWORK

Guidelines for Information Facilities Characteristics Survey

The attached list represents those information activities that the Battelle Memorial Institute research team identified in the House and COSATI reports made available by the Consumer Protection and Environmental Health Service. In some cases, while identification was possible, no substantive knowledge of the activity operation in itself was available.

The list is a guide to the selection of information facilities to be included in the survey. Deletions, combinations, or additions should be made whenever the knowledgeable individual in each commission who is administering the survey judges a change desirable.

The following guidelines are suggested for identification of additional information facilities for inclusion in the survey. All guidelines need not apply before a facility is selected.

- Include any formal information storage and retrieval effort other than the alphanumeric storage of documents in conventional letter files.
- Do not include personal information systems intended only to serve the specific needs of one individual.
- Do not include information activities oriented primarily toward project information (such as would be contained on Forms FD-1609, NCU1-146, or PHS-5118), or toward monitoring and surveillance programs. Characteristics of such facilities will be obtained by other means and should be deleted from the attached list if they meet this criterion.
- To be included the information facility should be regularly responsive to needs of its parent organization or other organizational units not directly responsible for its operation. The response may consist of either evaluated or unevaluated information.
- Include if the information activity is a formally designated part of the organizational structure and its mission and objectives are primarily related to information functions.
- If in doubt whether or not to include a specific information activity, please include it. Too much is preferable to too little.

Instructions for Completing Catalog

of Information Facility Characteristics

The purpose for collecting information on your facility is to determine its relation to the overall information and data requirements of CPEHS. We would appreciate your providing the most complete and accurate information available. **IF YOU HAVE ANY QUESTIONS CONCERNING THIS INQUIRY, PLEASE CALL:**

Dr. Robert Medz
Federal Office Bldg. No.8
200 C Street, S.W.
Washington, D. C. 20024

Area 202, 962-7361

Remarks on specific questions

Question No.

2. We are primarily interested in your information facility's channels and its formal relationship to other organizations within the same department.
7. Although some activities within your organization may be in different stages, i.e., some in the planning stage and others in the operational stage, we are concerned with the overall status of the activity.
11. This question has four basic parts:

    (a) type of documents in the system,
    (b) number of each type in the system,
    (c) sources of these documents, and
    (d) major source of each type. Please try to answer for each type of document within the system.
14. If you are uncertain as to your response to Question 14, Question 15 lists what we consider non-query services.
18. This question is directed toward lag-time between receipt of an inquiry and response by the activity to the requestor.
19. Examples of specific technical communities are: practicing physicians, pharmacists, physicists, radiologists.
20. Indicate by number those individuals within your own activity who request searches or non-query services. Do the same for those within CPEHS including your own activity and those within HEW but outside CPEHS. The number in the Government column should include "CPEHS" and "HEW outside CPEHS" users as well as any other within the U.S. Government.
21. We are concerned here with restrictions on the system which prevent some persons from using all its services. Some systems may be restricted for internal use only by its own employees. Others may provide services to anyone requesting information.
22. By cost of services we mean cost to the user. In other words, do you charge for your services or products? If so, how much? On what basis?
26. Question 27 will clarify what is meant by indexing terminology authority in Question 26. You may store your index on "peek-a-boo" cards and your index authority (or thesaurus) on 3" x 5" file cards. We are interested in this question only with the means of storage of the index, not the index authority.
31. This question is not meant to include standard typewriters, adding machines, etc. It does include tape-driven typewriters, tub-files, card sorting devices and, of course, computers. If in doubt, include the item in the list.
33. Indicate the subject specialties in which your professional employees are currently engaged--not their academic background.
34. This question is concerned with what services your information activity contracts out rather than performing in-house.

Thank you.

CATALOG OF INFORMATION FACILITY CHARACTERISTICS
FOR A
CONSUMER PROTECTION AND ENVIRONMENTAL HEALTH INFORMATION NETWORK
(Abbreviated Form)

Prepared for use on Contract No. CPS 69-005

BATTELLE MEMORIAL INSTITUTE
Columbus Laboratories
505 King Avenue
Columbus, Ohio   43201

SYSTEM GENERAL CHARACTERISTICS

1. Name of the information activity, center, system, or service.

   ____

2. Name of parent organization. If **government**, attach an organization chart or, starting with the first level **above the information** activity, specify the organizational reporting **channels up to the Department** level.

   ____

   ____

3. Name and title of the **manager of the activity named** in Question 1 above.

   ____

4. Address of the activity. ______________________________

   ____

5. Telephone number of the activity. ______________________________

6. Year the activity was started. ______________________________

7. Status of the activity.

   a. Planning stage   b. Development   c. Implementation

   d. Pilot   e. Operational

8. Mission (the chief function or responsibility of the activity.)

   ____

   ____

   ____

   ____

   ____

9. Major subject fields covered. ______________________________

   ____

   ____

   ____

   ____

10. Enclose any available narrative description, published or non-published, that describes equipment, work flow, operation, or other aspects of your activity. You may find it more convenient to answer Question 10 after completing the remainder of this summary.

SYSTEM INPUT CHARACTERISTICS

11. Please check the types of documents or information sources specifically scanned for inputs into activity. Indicate which are physically retained (regardless of where), by writing in the total quantities collected to date. (Where statistics are unavailable or unknown for a given type of document or source, please write in "NS".) Under the heading "Sources" indicate whether or not you obtain documents from each source listed (no numbers required) and identify which of these is the major source.

	Total Quantities Collected To Date	Sources				
Types		FDA	NAPCA	ECA	Outside CPEHS	Which one is the Major Source?
(01) ☐ Books and/or monographs	________	☐	☐	☐	☐	
(02) ☐ Articles from journals, meeting proceedings, or review publications (if retained as whole issues, and/or bound volumes, write "WI" and/or "BV" after quantities)	________	☐	☐	☐	☐	
(03) ☐ Abstracts from internal or external abstracting publications or services	________	☐	☐	☐	☐	
(04) ☐ Research and/or development reports	________	☐	☐	☐	☐	
(05) ☐ Clinical reports	________	☐	☐	☐	☐	
(06) ☐ Laboratory or test reports	________	☐	☐	☐	☐	
(07) ☐ Patents	________	☐	☐	☐	☐	
(08) ☐ Data sheets, cards, forms	________	☐	☐	☐	☐	
(09) ☐ Correspondence	________	☐	☐	☐	☐	
(10) ☐ Research or development project descriptions	________	☐	☐	☐	☐	
(11) ☐ Specifications and/or standards	________	☐	☐	☐	☐	
(12) ☐ Blueprints and/or drawings	________	☐	☐	☐	☐	
(13) ☐ Photographs	________	☐	☐	☐	☐	
(14) ☐ Motion pictures (if retained give number of reels collected)	________	☐	☐	☐	☐	
(15) ☐ Operating or instruction manuals	________	☐	☐	☐	☐	

		Sources				
Types	Total Quantities Collected To Date	FDA	NAPCA	ECA	Outside CPEHS	Which one is the Major Source?
(16) ☐ Directories	________	☐	☐	☐	☐	
(17) ☐ Vendors literature and/ or catalogs	________	☐	☐	☐	☐	
(18) ☐ Theses	________	☐	☐	☐	☐	
(19) ☐ Compendia of data (handbooks, critical tables, etc.)	________	☐	☐	☐	☐	
(20) ☐ Translations	________	☐	☐	☐	☐	
French	________	☐	☐	☐	☐	
German	________	☐	☐	☐	☐	
Spanish	________	☐	☐	☐	☐	
Russian	________	☐	☐	☐	☐	
Italian	________	☐	☐	☐	☐	
Other	________	☐	☐	☐	☐	
(21) ☐ Travel or trip reports	________	☐	☐	☐	☐	
(22) ☐ Clippings	________	☐	☐	☐	☐	
(23) ☐ Bibliographies	________	☐	☐	☐	☐	
(24) ☐ Personnel or organization background records	________	☐	☐	☐	☐	
(25) ☐ Market reports	________	☐	☐	☐	☐	
(26) ☐ Sales reports (company)	________	☐	☐	☐	☐	
(27) ☐ Sales reports (industry-wide)	________	☐	☐	☐	☐	
(28) ☐ Meeting minutes or proceedings (internal)	________	☐	☐	☐	☐	
(29) ☐ Financial reports (internal)	________	☐	☐	☐	☐	
(30) ☐ Others (please specify)	________	☐	☐	☐	☐	
________________	________	☐	☐	☐	☐	
________________	________	☐	☐	☐	☐	
________________	________	☐	☐	☐	☐	
Grand Total of Documents in Collection	________					

12. Identify the major sources of monitoring and surveillance data relied upon as input for your activity:
    1. ☐ National Air Sampling Networks
    2. ☐ National Water Control Network
    3. ☐ Ohio River Valley Water Sanitation Commission
    4. ☐ Other (specify)

13. Describe any contemplated changes in the inputs for your activity.

____

____

SYSTEM OUTPUT CHARACTERISTICS

14. Does your activity perform any services other than searches or answering reference questions?

(01) ☐ no If your answer was "no", proceed to Question 16.
(02) ☐ yes If your answer was "yes", proceed to Question 15.

15. Please indicate which of the following non-query services or products are furnished by your activity. Indicate in each case the number of issues or transactions per month. Where statistics are unavailable or unknown, please write in "NS".

			No. of Issues or Transactions Per Month
(01)	☐	Accession or new acquisition lists	
(02)	☐	Recurring bibliographies	
(03)	☐	Conventional printed indexes	
(04)	☐	Abstracting and/or indexing publications	
(05)	☐	Sets of library catalog cards	
(06)	☐	Printed book catalogs	
(07)	☐	Permutation indexes (KWIC, KWOC, etc.)	
(08)	☐	Uniterm cards	
(09)	☐	Dual Uniterm printed indexes	
(10)	☐	Proceedings	
(11)	☐	Monographs/Books	
(12)	☐	Data Sheets	
(13)	☐	Computer Programs	
(14)	☐	Tape Services (Describe)	
(15)	☐	Microforms (Describe)	
(16)	☐	Preprints	
(17)	☐	Reprints	
(18)	☐	Copy Service	
(19)	☐	Periodicals/Journals	
(20)	☐	Translations	
(21)	☐	Specifications	
(22)	☐	Standards	
(23)	☐	Thesauri	
(24)	☐	Audio-Visual material	
(25)	☐	Loan Services	
(26)	☐	Compilations/Handbooks	
(27)	☐	Notices, selective dissemination of information (SDI)	
(28)	☐	Reviews, Evaluations, Correlations	
(29)	☐	Document circulation records	
(30)	☐	Journal lists and/or renewal records	
(31)	☐	Accounting and other housekeeping records	
(32)	☐	Other services not concerned with search or reference requests (please specify)	

16. **Types of reference and query response services performed by your activity.**
☐ None (proceed to Question 19. Otherwise fill out table.)

Service	Monthly Frequency
Searches of activity holdings (What is in the activity on a given subject?)	
Prior art searches (What exists in the literature on a given subject?)	
Direct retrieval of explicit factual statements (melting points, definitions, descriptions or processes, chemical structures, numerical data, etc.)	
State-of-the-art reviews (analysis and synthesis of the results of literature searches to determine the current status of specified fields or topics)	
Referral Service	
Others (specify)	

17. Please check the form(s) of response to reference request that are furnished by your activity output.

Form Furnished User
(01) ☐ Document numbers (as in Uniterm or peek-a-boo systems)
(02) ☐ Report numbers (such as AI-68-24, BSD-TR-66-24, etc.)
(03) ☐ Bibliographic citations (author, title, etc.)
(04) ☐ Citations plus abstracts or extracts
(05) ☐ Documents in full size
(06) ☐ Documents in microform
(07) ☐ Explicit factual statements (melting points, definitions, etc.)
(08) ☐ State-of-the-art reports
(09) ☐ Data, tables, graphics
(10) ☐ Machine searchable magnetic tapes
(11) ☐ Other forms (specify)

18. Estimate the percentage of queries that are answered by your activity within one week, within two weeks, within three weeks, and three or more weeks.
Answered within one week ______________%
Answered within two weeks ______________%
Answered within three weeks ______________%
Answered in three weeks or more ______________%

19. **Specific technical communities served.** ____________________

____

____

____

20. Classification and number of users per month.

Users	Activity Employed	Within CPEHS	HEW outside CPEHS	Government	Non-Government
Research Personnel	____	____	____	____	____
Management Personnel	____	____	____	____	____
Total	____	____	____	____	____

21. Limitations on use. ____________________

____

____

____

22. Cost of services. ____________________

____

____

23. Describe any contemplated changes in the output services and products of your activity. ____________________

____

____

____

____

____

____

____

SYSTEM INTERNAL CHARACTERISTICS

24. What is the medium of storage of the documents that are retained? Please check.
    (01) ☐ Full-size copy
    (02) ☐ Microcards (opaque)
    (03) ☐ Roll microfilm
    (04) ☐ Aperture cards
    (05) ☐ Microfiche or sheet microfilm
    (06) ☐ Punched cards
    (07) ☐ Magnetic tape
    (08) ☐ Magnetic disc
    (09) ☐ Others (specify) ____

____

____

25. What items are indexed? What type of index is used for each? Please check.

	Type of Index				
Items Indexed	Inverted Coordinate	Clue Word (Uniterm)	Permuted	Alpha-Numeric	Other
(01) ☐ Subject or concept terms, headings, or descriptors	☐	☐	☐	☐	☐
(02) ☐ Trade, product, or systematic chemical names	☐	☐	☐	☐	☐
(03) ☐ Molecular or structural formulae	☐	☐	☐	☐	☐
(04) ☐ Functional groups	☐	☐	☐	☐	☐
(05) ☐ Biological, chemical or physical properties	☐	☐	☐	☐	☐
(06) ☐ Personal author	☐	☐	☐	☐	☐
(07) ☐ Organizational or corporate author	☐	☐	☐	☐	☐
(08) ☐ Project name or number	☐	☐	☐	☐	☐
(09) ☐ Report number (if different from project number)	☐	☐	☐	☐	☐
(10) ☐ Contract number	☐	☐	☐	☐	☐
(11) ☐ Title	☐	☐	☐	☐	☐
(12) ☐ Security classification	☐	☐	☐	☐	☐
(13) ☐ Type of form of document (book, report, etc.)	☐	☐	☐	☐	☐
(14) ☐ Type of activity (research, development, engineering, etc.)	☐	☐	☐	☐	☐
(15) ☐ Geographic location of originating organization	☐	☐	☐	☐	☐
(16) ☐ Date of issuance or publication	☐	☐	☐	☐	☐
(17) ☐ Date of receipt	☐	☐	☐	☐	☐
(18) ☐ Accession number	☐	☐	☐	☐	☐
(19) ☐ Other (please specify) ______________________________					

____

____

____

26. What is the medium of storage of your index (not indexing terminology authorities or sources)? Please check.

(01) ☐ Manual cards (3x5, 5x8, etc.)
(02) ☐ Uniterm cards (not peek-a-boo)
(03) ☐ Peek-a-boo cards
(04) ☐ Edge-notched punched cards
(05) ☐ Standard punched cards
(06) ☐ Punched paper tape
(07) ☐ Magnetic tape
(08) ☐ Magnetic disc
(09) ☐ Microform
(10) ☐ Book or other page arrangement
(11) ☐ Others (please specify) ______________________________

____

27. Please check any of the listed indexing terminology authorities that are used in connection with the activity.

(01) ☐ No authority used (please proceed to Question 30)
(02) ☐ Library of Congress List of Subject Headings
(03) ☐ American Institute of Chemical Engineers (AIChE) Thesaurus
(04) ☐ National Library of Medicine Medical Subject Headings (MeSH)
(05) ☐ Thesaurus of Engineering & Scientific Terms (DOD, EJC)
(06) ☐ Authority made especially for your organization (describe below with any others used)
(07) ☐ Others (please specify)

28. Number of terms or headings that are presently used in subject indexing terminology authority of your activity. __________
☐ Statistics unavailable or unknown

29. If your activity has its own thesaurus, please check any of the following listed indexing terminology authorities used as a basis for, or to assist in developing your own authority. Attach a copy of your thesaurus.

(01) ☐ Library of Congress List of Subject Headings
(02) ☐ American Institute of Chemical Engineers (AIChE) Thesaurus
(03) ☐ National Library of Medicine Medical Subject Headings (MeSH)
(04) ☐ Thesaurus of Engineering & Scientific Terms (DOD, EJC)
(05) ☐ Others (please specify) ______________________________

____

____

30. Does your activity use punched cards, paper tape, magnetic tape, or other media for which you have developed or are using special fixed formats for information or data for machine manipulation? If so, please provide information on these formats. ______________________________

____

____

31. **List the number of units, and the manufacturers' name and model number of all equipment that is used in your information activity. (This includes such peripheral and "off-line" equipment as keypunching machines, tape typewriters, printers and photoduplication equipment.)**

No.	Name of Manufacturer and Type of Equipment	Model No.	Shared? Yes	Shared? No	On Site	Remote Location	Where
			☐	☐			
			☐	☐			
			☐	☐			
			☐	☐			
			☐	☐			
			☐	☐			
			☐	☐			
			☐	☐			
			☐	☐			
			☐	☐			

32. Please describe any contemplated changes or additions in the equipment used in your activity.

33. Personnel:

a. Professional (disciplines)

No.	Subject Area of Specialty

b. Support (types)

No.	Function

34. Information Service Contracts (in effect or contemplated): (Scope, contractor, dollar value, period)

Note: Be sure to include the material requested in Questions 10, 29, and 30.

Thank you for your fine cooperation.

APPENDIX B

LIST OF INFORMATION SOURCES FOR USE IN THE LEAD AND PESTICIDE MODEL CASE STUDIES

APPENDIX B

LIST OF INFORMATION SOURCES FOR USE IN THE LEAD AND PESTICIDE MODEL CASE STUDIES

Lead Model Case Study

Outside EHS

Toxicology Literature
Pharmacology Literature
Toxicology Information Program (National Library of Medicine)
Medlars
National Disease and Therapeutic Index
LEA Associates
National Center for Health Statistics
American Academy of Pediatrics
Baltimore City Health Department
ICRP Tables
MERCK Index
Sax-Handbook
Lead Industries Association
International Lead-Zinc Research Organization
U. S. Bureau of Mines
U. S. Bureau of Census
Bureau of Labor Statistics
National Association for Retarded Children
National Clearinghouse for Poison Control Centers
Poison Control Center (Children's Hospital, Columbus, Ohio)
American Bureau of Metal Statistics
Center for Air Environment Studies (Guide to Air Pollution Research)
Science Information Exchange
Commission on Professional and Hospital Activities

NAPCA

Air Pollution Technical Information Center
Pollutant Effects Network
Air Pollution Health Effects Network
Categorical Pollution Emissions Surveys
Pollution Source Inventory
Major Industry and Process Emissions Survey
SAROAD
Office of Research Grants - Air Pollution Control
  Active Research Grants for FY 1969

ECA

Epidemiologic Data Base
Toxic Chemical Information System
National Occupational Health Monitoring System
Scientific Reference System
National Water Quality Register

NAPCA Personnel

Health Effects Research Program
  Dr. Carl Shy
  Dr. Douglas Hammer
  Dr. R. J. M. Horton
  Dr. Ferris Benson
  Cecil Pinkerton

ECA Personnel

Division of Criteria and Standards
  Andrew Hosey

Non-EHS Personnel

Dr. J. Chisolm Johns Hopkins Medical School
Mr. Benjamin Wake - Montana State Department of Health
Dr. Revena Brown - Children's Hospital, Chicago, Illinois

Pesticide Model Case Study

Outside EHS

U. S. Fish and Wildlife Service
Plant Pest Control Division, USDA
California Department of Public Health
U. S. Bureau of Census
Federal Water Pollution Control Administration
American Public Health Association
U. S. Department of Interior
National Communicable Disease Center
California Department of Water Resources

Non-EHS Personnel

Dr. John E. Swift - University of California
Agricultural Extension Service

Dr. Homer R. Wolf - Wenatchee Research Section, FDA

APPENDIX C

LIST OF JOURNALS AND TEXTBOOKS FOR USE IN THE LEAD AND PESTICIDE MODEL CASE STUDIES

APPENDIX C

LIST OF JOURNALS AND TEXTBOOKS FOR USE IN THE LEAD AND PESTICIDE MODEL CASE STUDIES

Lead Model Case Study

Journals

Environmental Science and Technology
Chemical Week
Metal Industry
Chemistry and Industry
Public Health Service Publications
Chemical and Engineering News
Archives of Environmental Health
American Journal of Diseases of Children
Lancet
Archives of Disabled Children
Journal of Medicine
Journal of Metabolism and Deficiency Research
Journal of Pediatrics
Science
Journal of AOA
Clinical Chemistry
Chemical Engineering
Journal of the American Medical Association
Clinical Pharmacology Therapeutics
Industrial Medicine and Surgery
Journal of Occupational Medicine
Archives of Neurology and Psychiatry
New England Journal of Medicine
Toxicology and Applied Pharmacology
British Medical Journal
American Journal of Surgery
Annals of the New York Academy of Science
New Scientist
Technical Survey
Medical World News
Clean Air and Water News
Industrial Medicine
Drug Research Reports
Cosmetics
ASHRAE Journal
Journal of the Air Pollution Control Association
Buyer's Guidebook for Chemicals
Electronic News
Food Additives - Federal Register
Vital Statistics
Employment and Earning Statistics

Index Medicus
Census of Manufacturers (Bureau of Census)
Nature
Lead Abstracts
Biological Abstracts
Chemical Abstracts

Textbooks

Toxicity of Industrial Metals
Industrial Hygiene and Toxicology
Handbook of Toxicology
Pharmacology
The Pharmacological Basis of Therapeutics
Clinical Toxicology of Commercial Products
Handbook of Analytical Toxicology

Pesticide Model Case Study

Journals

Journal of Agricultural and Food Chemistry
Air Pollution Control Association (Journal)
Science
Archives of Environmental Health
Journal of Economic Entomology
American Chemical Society (Journal)
Soil Science Society of America Proceedings
Annual Review of Microbiology
Residue Reviews
Nature
New Zealand Journal of Agricultural Research
World Health Organization Bulletin
Utah Agricultural Experiment Station (Bulletin)
United States Fish and Wildlife Service (Circular)
American Society of Agronomy (Special Publication)
Pesticides Monitoring Journal
Agricultural Chemicals
Agronomy Journal
Soil Science
American Water Works Association (Journal)
Annals of Applied Biology
Public Health Reports
American Medical Association (Journal)
Toxicology and Applied Pharmacology
Canadian Medical Association Journal
Scientific American
BioScience
Bambusia Affinis
Chemical Abstracts

Biological Abstracts
Cytologia
Journal of Wildlife Management
Cancer Research
Archives of Industrial Hygiene and Occupational Medicine
Royal Society of Tropical Medicine and Hygiene Transactions
New York Academy of Science (Annals)
International Journal of Industrial Medicine and Surgery
Toxicology and Applied Pharmacology
Food and Cosmetics Toxicology
Chemistry and Industry
Canadian Journal of Biochemistry and Physiology
Canadian Medical Association Journal
Mutation Research
Genetics
Japanese Journal of Genetics
Journal of Horticultural Science
Weeds
Pure and Applied Chemistry
Biochemical Pharmacology
Society for Experimental Biology and Medicine Proceedings
Industrial Medicine and Surgery
Acta Pharmacologica et Toxicologica
Journal of the Mississippi Academy of Sciences
Voprosy Pitaniya (Problems of Nutrition)
Phytoma
Agricultural Statistics
National Conference on Water Pollution Proceedings (USPHS)

Textbooks

Cleaning Our Environment: The Chemical Basis for Action
Report of the Secretary's Commission on Pesticides and Their Relationship to Environmental Health, Parts I and II
Air Pollution Aspects of Pesticides
Pesticidal Formulations Research, Physical and Colloidal Chemical Aspects
Clinical Handbook of Economic Poisons
Research in Pesticides
Air Pollution Engineering Manual
First Rochester Conference on Environmental Toxicity

APPENDIX D

INFORMATION ANALYSIS CENTERS

APPENDIX D

INFORMATION ANALYSIS CENTERS

Definitions of an Information Analysis Center

Information analysis centers existed long before their functions were rigorously defined and they were recognized as a distinct type of information service. The first known attempt at a formal definition appeared in 1962(1)*, some 11 years after the first Battelle-operated center was established. As these organizations have earned their place in the total system for communicating scientific and technical information, their activities have come into better focus. The following working definition by Simpson illustrates Battelle's concept of an information analysis center:(2)

> **One or more scientists, engineers, and information specialists, committed, at least part time, to providing to a specialized audience, the technically intellectual service of evaluating, integrating, condensing, and analyzing available information or data in a specific area of science or technology, or pertaining to a specified mission. The center provides answers to technical questions and provides to its specialized audience authoritative and timely data arrays, analyses, monographs, or state-of-the-art reports.**

This definition is similar to and is an extension of the concept originally presented in the Weinberg report on "Science, Government, and Information"(3) and the definition accepted by the U. S. Department of Defense.(4) The definition as presented by the Department of Defense reads as follows:

> Any functional element is performing as an information analysis center if it collects, reviews, digests, analyzes, appraises, summarizes, and provides advisory and other user services concerning the available scientific and technical information and data in a well-defined, specialized field. A center exclusively concerned with review and analysis of scientific or engineering data shall be considered an information analysis center. Such centers are distinguished from documentation centers and libraries, whose functions are primarily concerned with the handling of documents rather than the technical information contained in the documents.

The Information Analysis Center Concept

An information analysis center consists of three major operational elements: (1) an information and/or data acquisitions program, (2) a means for storing and selectively retrieving information and/or data, and finally (3) the response mechanism which produces technical responses to inquiries, technical compilations, and analyses. These functions are shown in Figure D-1. While this concept has been discussed in several papers by Simpson(2), it is desirable to review it in some depth, because it is basic to Battelle's information analysis philosophy.

---

*References are listed on page D-8.

The Acquisition Function

The top third of the chart represents the acquisition function – scientific information centers must identify and obtain the current data and information needed by their customers. If this is not achieved, the remainder of the center's efforts are jeopardized. To be able to identify what is important in the total information available requires trained information specialists plus the cooperative assistance of scientists and engineers. Maximum advantage must be taken of the technical staff in identifying the sources of information most important to the center. Further, the best means for insuring high-quality input is to give the technical staff the opportunity to review all material before it is accepted. Qualitative considerations(5) are vitally important to the center's program for collecting information and data. The acceptance of material that is nonrelevant to the center's mission, that is duplicated, or is outdated entails unnecessary expense not only in the original processing costs, but also in recurring costs each time it is retrieved, considered, and rejected.

Information Storage and Retrieval Function

The middle section of Figure D-1 represents the storage and retrieval functions of this center. It has been Battelle's experience and observation that the method which an information analysis center employs to store and retrieve information can be grossly overemphasized. The matter of system selection should be approached as a problem in resource allocation: to minimize expenditures for system operation and maintenance and to maximize expenditures on output. This is, of course, an oversimplification of a complex problem that will be treated more fully in a later section of this report, insofar as it affects EIAC. In general, however, it is a rare instance when a center is not to some degree fund-limited. It is basic to Battelle's philosophy of center operation that "trade-offs" should, in general, be resolved in favor of output functions.

The Analytical/Production Function

The final portion of the chart is the most important and, as described by Simpson(2), concerns money. Money comes from a sponsor or from a buyer of the services provided by an analysis center. The service provided by an analytical center ultimately takes the form of a report (in a broad sense), oral or written. Whether the sponsor is satisfied by the service depends not only on the thoroughness and economy of the center's operation, but also on his acceptance of the products of the center. The center's administrative staff must maintain an awareness of the proper preparation of its products, the most important characteristics being authoritativeness and timeliness.

Any center's greatest challenge is that of remaining responsive to the changing requirements of its patrons; requirements that change because modern technology is changing rapidly. The technical staff associated with the center is obviously in the best position to insure that the center adequately anticipate and adjust to the needs of its users. They must be in a position to make the necessary judgments and have the opportunity to express these judgments to the center's management.

There are three mechanisms by which Battelle-operated centers keep their technical staffs equipped to perform this vital task of orienting the center toward the user's needs: first, through day-to-day contact with the user in the course of answering his inquiries; second, by encouraging the staff to attend and participate in important

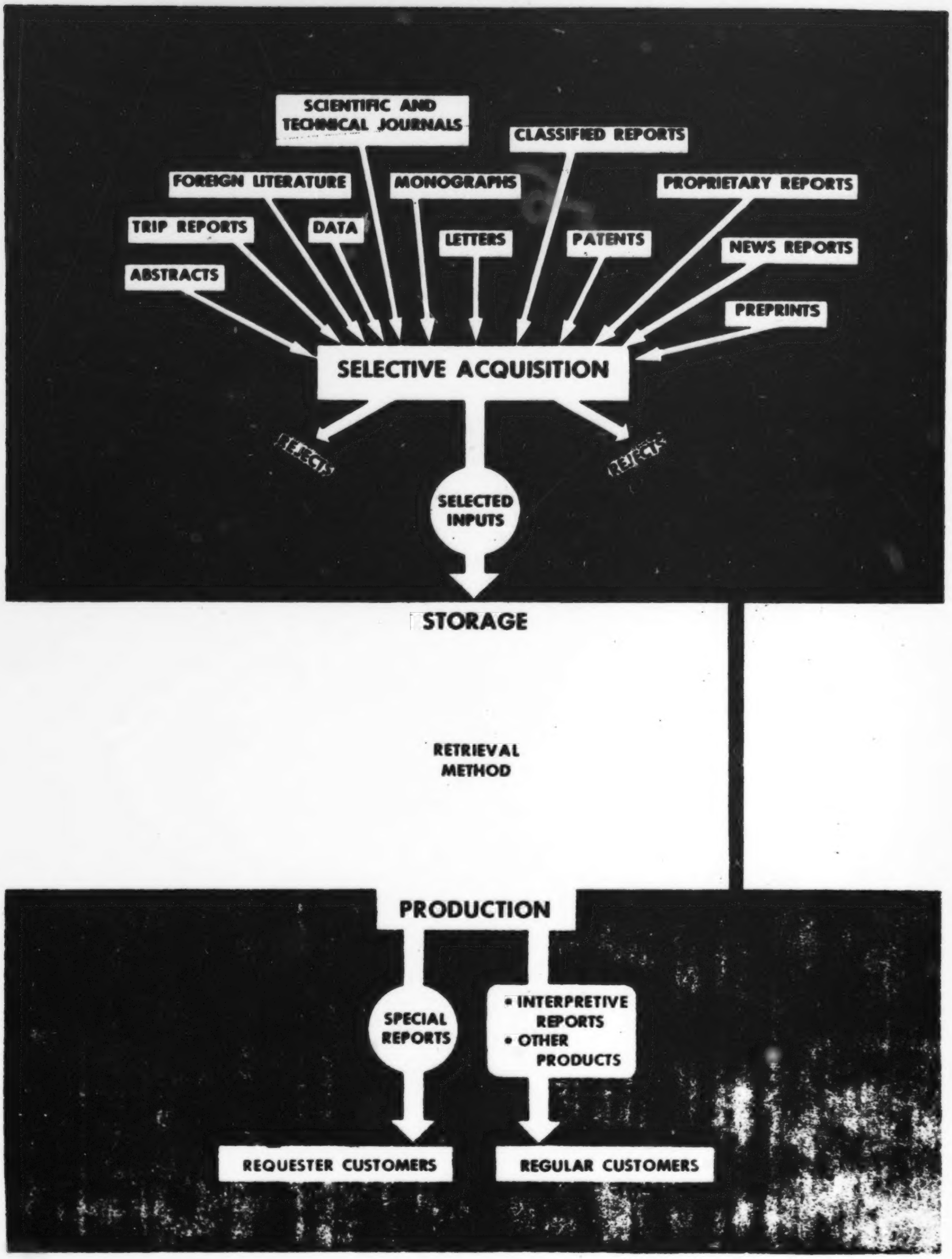

SCIENTIFIC AND TECHNICAL JOURNALS
CLASSIFIED REPORTS
FOREIGN LITERATURE
MONOGRAPHS
PROPRIETARY REPORTS
TRIP REPORTS
DATA
LETTERS
PATENTS
NEWS REPORTS
ABSTRACTS
PREPRINTS
SELECTIVE ACQUISITION
REJECTS
REJECTS
SELECTED INPUTS
STORAGE
RETRIEVAL METHOD
PRODUCTION
SPECIAL REPORTS
• INTERPRETIVE REPORTS
• OTHER PRODUCTS
REQUESTER CUSTOMERS
REGULAR CUSTOMERS

FIGURE D-1.
THE PRIMARY FUNCTIONS OF SCIENTIFIC INFORMATION ANALYSIS CENTERS

technical meetings and working groups; third, by constantly exposing the staff to the latest published, and often unpublished, information in their fields as it is acquired by the center.

The technical staff must be encouraged to express their judgments regarding trends in their fields of specialization. An effective means for soliciting these judgments at Battelle has been to formally request the identification of candidate subjects for report tasks. Consultation with the technical staff establishes an order of priorities for the tasks to be supported, and identifies for center management those areas where its services will be most needed.

Relationship of the IAC to the User Audience

Figure D-2 is a schematic representation of an information analysis center and its relationship to the user audience.(6) This diagram is consistent with and develops an operational concept of the accepted definition of an information analysis center. It is important that the concepts presented in this diagram be thoroughly understood by both the technical staff and the information specialists. In explaining the relationship of the user audience to the IAC, it is desirable to use a scenario approach.

To the left is a user audience, which may be either discipline-oriented (i.e., chemistry, metallurgy, forestry, or mining), or mission-oriented (forest exploitation, ballistic missile, pollution reduction, defense, or rural development). The user audience may be either widespread geographically and diffuse in their individual interests or centrally located (i.e., within a given organization). It is important that the user audience be defined and understood in depth, since the center's products must be developed to meet their needs. The users' direct and indirect expression of these needs provides the necessary guidance for the design of the center's products.

Within the context of the information analysis centers located at Battelle, RACIC is mission oriented, highly diffuse in scope, and serves a very select audience that is widely separated geographically. On the other hand, DMIC is more discipline oriented (metallurgy), more limited in scope (certain high-temperature metallic materials used in defense systems), and serves a relatively broad American audience.

Within the user audience, the dot represents a specific user who is faced with a problem. The solution to his problem may or may not be in the literature. He may have exhausted his local sources, i.e., fellow experts, local libraries, etc. At this point he may decide to contact an IAC. If this is his first dealing with an IAC, he may state his request in terms of documentation:

- "Please send me all the literature you have on..."
- "Please send me a bibliography on..."

The IAC Project Director will have established a corps of experts (the Technical Specialist Interface) which (viewed collectively) matches the interests of the defined user audience. Within the Battelle context, the technical specialists are "lab-bench" scientists and technologists who are available part-time (as required) to assist the center. Their task is that of interpreting the user's needs, analyzing pertinent information and data, developing a reply, and communicating the reply to the user in terms that he can best understand.

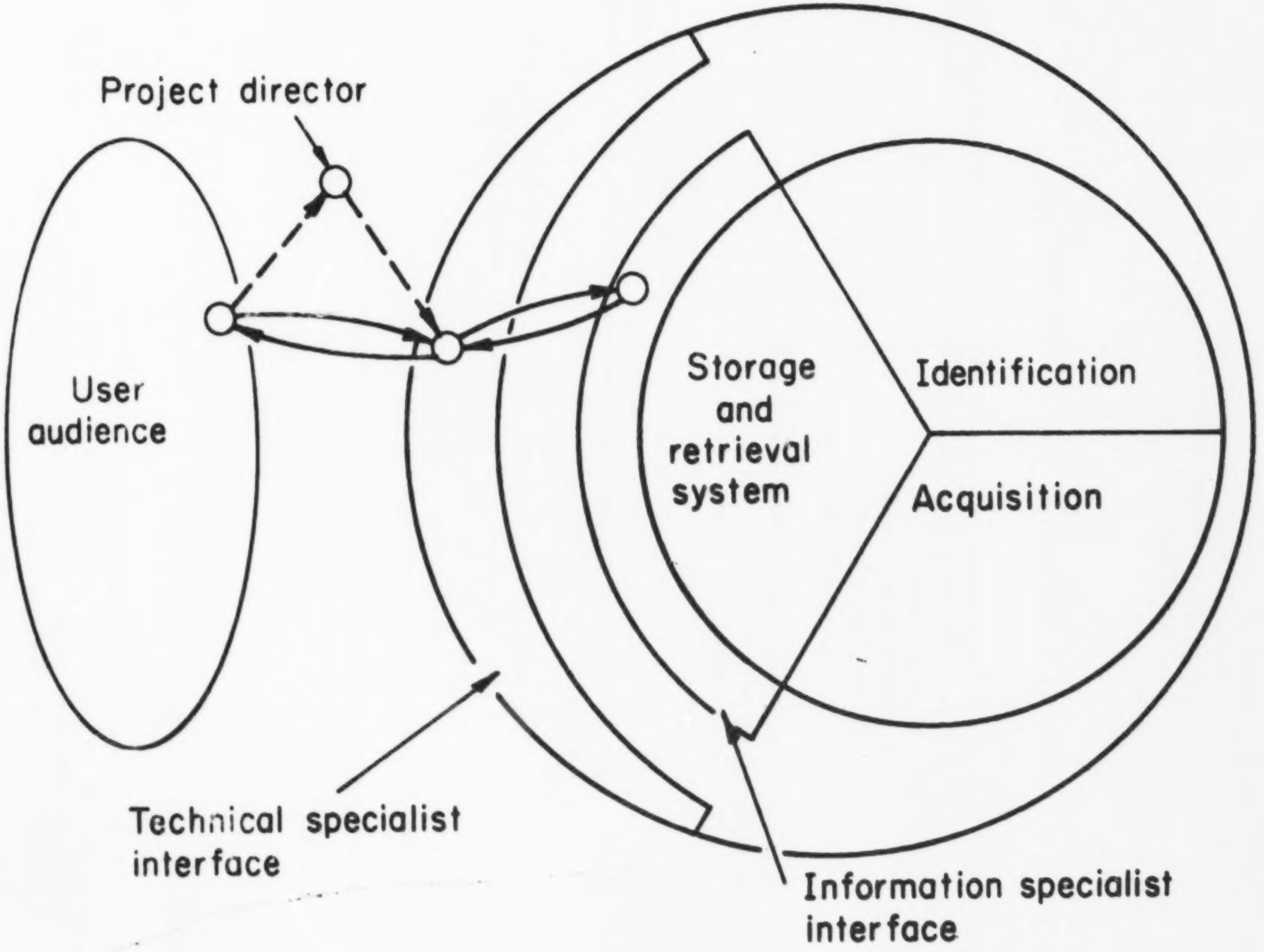

Project director
User
audience
Storage
and
retrieval
system
Identification
Acquisition
Technical specialist
interface
Information specialist
interface

FIGURE D-2. THE IAC-USER AUDIENCE RELATIONSHIP

The Project Director will select the best-qualified expert to respond to the user inquiry (as indicated by the broken arrows). Often, the expert will immediately contact the user-inquirer to obtain clarification of the original inquiry. Since the communication at this point is between fellow specialists (the solid arrows), the discussion will become technical in nature, and a technological rapport will develop. No longer is the communication (inquiry) in documentation terms, as above, but rather in explicit technical language.

Frequently, the technical expert will have a ready answer. He may be able to refer the problem to a fellow expert within the technical-specialist interface; perhaps he will suggest a knowledgeable source within the user audience; or he may have to refer to the information backup within the center to develop a solution to the stated problem.

In most IAC's the information backup takes the form of a specialized collection distilled from the general literature and indexed in the language of the center's mission, rather than in the stylized terms of the traditional index.

This deeply indexed body of information and/or data, the storage and retrieval system, is shown to the right in Figure D-2. Care must be exercised to select an information storage and retrieval system which will match the specific use patterns and requirements of both the user audience and the technical interface. System costs, both for establishment and for operations, would not be greater than the recognizable benefits of the system.

Since the members of the technical interface are primarily concerned with their areas of technical endeavor, they require a backup to operate the information system. The Information Specialist Interface at Battelle consists of knowledgeable scientists and technologists who have chosen not to be "lab-bench" scientists. This staff is oriented toward science information (i.e., chemistry, ecology, electronics, etc.) and toward the information science field (i.e., information-system design, communication theory, etc.).

Playing a dual role, this staff is able to communicate with the technical interface and to understand their information and data requirements in terms of both the center's system and other resources which might be useful (libraries, documentation centers, other IAC's, etc.).

Completing the concept is the all-important area of identification and acquisition of useful information which is discussed at length in the preceding section of this report (page D-2).

Information Analysis Center Versus Documentation Center

An important point to be gained from Figure D-2 is the differentiation between an information analysis center and a documentation center*. If there is no technical interface between the user and the information system, including the information specialists, then there is no true analysis center.

---

*Documentation Center: an organization that performs all of the functions of a document center, i.e., selecting, acquiring, storing, and retrieving specific documents, and, in addition, announces, abstracts, extracts, indexes, and disseminates documents in response to requests (for secondary distribution) expressed as accession numbers, subjects, titles, authors, sponsoring agencies, or contract or grant numbers, etc. The output of a documentation center consists of the documents received, or copies of them, indexes, bibliographies, catalog cards, announcement bulletins, and the like.(7)

Under these circumstances, the user approaches other information specialists or librarians directly. The conversation between the inquirer and the information specialist usually resolves into discussions of literature searches, bibliographies, requests for specific pieces of information, or references. Only under rare circumstances will the conversation be directed toward the specific technical problem which is behind the inquirer's need for information.

References

(1) Simpson, G. S., Jr., "Scientific Information Centers in the United States", American Documentation, 13 (1), 43-48 (January, 1962).

(2) Simpson, G. S., Jr., "Administration of Information Analysis Centers", in Toward a National Information System, Rubinoff, Morris, Editor. Proceedings of the Second National Colloquium of Information Retrieval, Philadelphia, Pennsylvania, April 23-24, 1965, Spartan Books, Washington, D. C. (1965), 242 pp.

(3) "Science, Government, and Information", A Report of the President's Science Advisory Committee, The White House, January 10, 1963, 52 pp. Available G.P.O., $0.25.

(4) "Centers for Analysis of Scientific and Technical Information", DOD Instruction 5100.45 (July 28, 1964).

(5) Simpson, G. S., Jr., and Murdock, John W., "Qualitative Approach to Scientific Information Problems", Battelle Technical Review, 11 (9), 3-7 (November, 1960).

(6) Darby, R. L., "Information Analysis Centers as a Source of Information and Data", Special Libraries, 59 (2), 91-97 (February, 1968).

(7) "Glossary of Fifty Definitions, Scientific and Technical Information", Scientific and Technical Information Handbook, U. S. Department of Defense, Vol 2, Section 4 (March, 1965).

APPENDIX E

THESAURUS RULES AND CONVENTIONS

Source: Thesaurus of Engineering and Scientific Terms. Prepared for U. S. Department of Defense by Office of Naval Research in joint operation with Engineers Joint Council, 1967. Available DDC, AD 672000.

BLANK PAGE

Appendix 1

Thesaurus Rules and Conventions

Approved November 9, 1966

Introduction

Building a thesaurus for vocabulary control in information storage and retrieval systems requires that certain decisions be made and recorded so that the thesaurus structure is internally consistent and reasonable. Moreover, users of a thesaurus need to know the rules and conventions upon which it is based for efficient and intelligent use.

These rules and conventions were used as the basic reference in the joint EJC-Project LEX development of an identical thesaurus for both Engineers Joint Council and the Department of Defense. The principles set forth should be generally applicable to thesaurus development and use. Uniform application of widely accepted thesaurus rules and conventions in information storage and retrieval systems may be expected to facilitate compatibility of systems for more efficient operation.

The thesaurus rules and conventions were prepared by a Task Group of the EJC Engineering Vocabulary Panel, Robert Dodds of Gibbs and Hill, chairman. Members of the Task Group were:

David M. Liston — Battelle Memorial Institute, chairman

Margaret Hicks — CFSTI, assigned to Project LEX

Jack W. Hilf — Bureau of Reclamation, Dept. of the Interior

Terry Gillum — DDC, assigned to Project LEX

Eugene Wall — Consultant to Project LEX

Indexing Terms—Descriptors[1]

The description of technical documents (indexing) for information storage and retrieval requires the use of two types of terms: (a) those that describe the information and data contained in the document, and (b) bibliographic terms—terms that describe the document itself, not the information in the document. Bibliographic terms, examples of which are personal authors, corporate authors, and publication dates, should not be included in the thesaurus. Terms that describe the information contained in the documents may include (1) project names, (2) military nomenclature, (3) identification symbols or numbers, (4) nicknames or jargon, (5) geopolitical names, (6) trademarks, (7) other proper names, (8) terms of an analytical nature, such as *anemometers, boundary layer, cardiovascular system, density, energy conversion, heat resistant alloys, spectroscopy;* and (9) terms of an abstract nature, such as *tests, measurement,* and *calibration.* The index terms of primary concern to the thesaurus are types 8 and 9. For convenient reference, terms selected to be entered into the thesaurus for use as indexing terms will be called "descriptors."

The rules and conventions for constructing the thesaurus are of three types: (1) those dealing with fundamental terms (T-1 to T-12); (2) those dealing with cross references (C-1 to C-8); and (3) the alphabetization rule (A-1).

T-1
Descriptor Selection

Descriptors should be selected for inclusion in the thesaurus on the basis of their estimated usefulness in communication, indexing, and retrieval. In general, utility of terms can be estimated by considering (a) the relative frequency of occurrence in the literature, (b) the relative frequency of use within an operating system, (c) relationships to descriptors that have been selected previously, and (d) scientific or technical precision and acceptability. These factors are very much interdependent and should be considered together in the selection of descriptors.

a. Frequency of prior use of a term in indexing and searching within a particular vocabulary gives a rough quantitative indication of its usefulness. The importance of frequency of use of a term depends upon the usage of other terms, the relative age of the term, and the age and scope of the collection. Terms that have been used relatively often within a given vocabulary may represent concepts that are poorly defined or too general to be useful in describing subject matter, whereas those that have been used very infrequently may represent concepts that are obscure or overly specific. Low frequency of use should not necessarily cause the rejection of a term that represents a novel concept and is a recent addition to the original vocabulary. The general rule is to establish descriptors that convey specifically the subject matter indexed. The utility of the terms can then be evaluated by reviewing their frequency of use in indexing.

---

[1] Examples of descriptors included in these rules and conventions are chosen for illustration only, and do not necessarily appear in the thesaurus.

b. As construction of the thesaurus progresses and descriptors are selected, an ad hoc vocabulary framework will emerge. This structure will help form a basis for the selection of additional descriptors. Candidate descriptors should be examined to determine that they reflect a level of specificity commensurate with that of the existing structure and that they represent discreet concepts. Avoid the selection of descriptors whose meanings coincide so closely with those of established descriptors that indexers (and searchers) will have difficulty in distinguishing between or among them.

c. The acceptability of terms can be determined by consulting dictionaries, encyclopedias, other indexing vocabularies, and the opinions of subject specialists. Slang, jargon, coined terms and deprecated terminology should be excluded.

d. It is usually desirable to establish a maximum term length for the purpose of maintaining succinctness of terms or for other special purposes such as maintaining the capability for a particular page format in a printed thesaurus. A maximum of 36 characters per term is recommended.

T-2

Noun Form

Use noun forms wherever possible; for example, *roughness* rather than *rough*. In a limited number of instances, needed retrieval concepts can be represented only by adjectives or equivalent expressions. These usually take the form of words or phrases that describe in some manner the operation of equipment or systems; for example, *airborne, mobile, portable*.

Never use verbs; for example, use *catalysis* rather than *catalyze*, the gerund *pouring* rather than the verb *pour*.

T-3

Singular vs. Plural

In choosing between singular and plural noun forms, a useful rule of thumb may be applied as follows: use the plural form when the proposed term is a count noun, that is, a noun which may be used to answer the question "how many?" (for example, devices such as *gages, nozzles, fuzes);* use the singular form for mass nouns, those that express "how much?" (for example, *iron, wood, charcoal)*; use the singular for specific processes, properties, or conditions. Table 1 provides a summary of the recommended procedure. Common usage should be followed for term types not covered in the above general rule or in the table.

T-4

Direct Entry

Descriptors consisting of two or more words should be listed in their natural word order, that is, the order normally used in English sentences; for example, *radar antennas* rather than *antennas, radar; refractory materials* rather than *materials, refractory*.

T-5

Descriptor Definition

Terms that have more than one accepted meaning, that are intended to be used in a somewhat different way than ordinarily defined, or for which distinctions from other descriptors must be drawn, should be accompanied by an explanation. The meanings of terms can be clarified or made more specific in the following ways:

a. Modifying terms can be used to preface a given term, as in *metal tubing* to make the meaning of the term *tubing* more specific. This is the method underlying the construction of direct entries (See Rule T-4) and is subject to the limitations of the rule on multiword descriptors (See Rule T-11).

b. A parenthetical qualifying expression can be appended to a homograph to clarify its meaning; for example, *mercury (metal)* and *mercury (planet)*. Such a qualifying expression becomes a part of the descriptor.

c. Employ the "–ing" suffix for processes and the "–ion" suffix or other appropriate suffixes for materials, characteristics, etc., when necessary to distinguish clearly among them. Examples are: *concentration* and *concentrating; precipitation* and *precipitating*.

d. When a qualifying expression cannot adequately convey the intended meaning, a short explanation called a scope note should accompany the term. Precise dictionary definitions usually should not be attempted. The scope note merely indicates the way in which the descriptor should be used. It is not a part of the descriptor, but follows on a succeeding line, as:

water cooling
cooling with water

e. Since trademarks are recognized by law as being proprietary, they should be identified in the thesaurus by the qualifying expression "(trademark)." When the meaning of a trademark is not self-evident, a scope note may also be added to clarify its meaning.

T-6

Synonyms

When two candidate descriptors are true synonyms, one should be selected as the descriptor, the other entered as a USE reference. (See Rule C-2a.)

T-7

Quasi-synonyms

To prevent scattering of like information in indexing and to obviate multiple searches for effective retrieval of information, it is both practical and desirable to consider terms having certain special relationships to be synonyms for indexing and retrieval purposes, that is, quasi-synonyms.

Terms that represent different viewpoints of the same property continuum may be considered quasi-synonyms; for example, *smoothness* and *roughness*. The

TABLE 1. GUIDELINES TO SINGULAR-PLURAL USAGE

TYPE OF TERM	*USE SINGULAR FORM*	*USE PLURAL FORM*
Material terms, such as: chemical compounds mixtures materials	When term is specific, as: urea cellophane beeswax	When term is generic, as: amines solvents plastics
Terms representing properties, conditions, characteristics	When term is specific, as: viscosity temperature purity opacity	When term is generic, as: physical properties process conditions
Terms representing equipment, devices, physical objects, and elementary particles	Do not use singular	Use plural, as: pulverizers regulators mesons teeth stars
Class of use terms	Do not use singular	Use plural, as: adhesives catalysts
Process terms	Use singular, as: constructing installing modulating	Do not use plural
Proper names (A proper name is defined as the name for a *single unique* item)	Use singular, as: Hookes Law Pluto	Do not use plural
Disciplines, fields, subject areas	Use singular according to common usage, as: chemistry hydraulics engineering	Do not use plural (Words such as "hydraulics" are actually singular)
Events or occurrences	Do not use singular	Use plural, as: ambushes explosions discharges

preferred term should be entered as a descriptor, the other as a USE reference. (See Rule C-2f.)

Terms representing concepts that overlap significantly may be treated as quasi-synonyms; for example, *lighting* and *illumination; duration* and *time; genetics* and *heredity*. The preferred term should be indicated by a USE reference. (See Rule C-2e.)

T-8
Punctuation

Punctuation marks in descriptors should be restricted. Highly specific systematic names, such as some chemical names, that require elaborate punctuation should be treated specially when they fall within the scope of the thesaurus. (See Rule T-10.) Parentheses should be used to enclose qualifying expressions which are included in descriptors to prevent ambiguity. (See Rule T-5.) Commas, periods, apostrophes and most hyphens should be excluded since they are difficult to handle consistently, complicate machine processing of the thesaurus, and are not necessary to convey the meaning of the terms. Hyphens should be used only in terms whose intended meaning would be altered by omission of the hyphen. In omitting a normally occurring hyphen, the space occupied by the hyphen should be handled according to these criteria: (1) retain the space for compound adjectives, noun-noun combinations, and letter-word combinations; (2) drop the space in attaching prefixes to the base words. Examples are:

(1) high temperature testing
man machine systems
n body problem

(2) countermeasures
microanalysis
ultrahigh frequency

T-9
Abbreviated Forms

In general, abbreviated terms should be avoided as descriptors because their understanding may not be universal, their meaning may be dependent on context, or their recognition may be dependent on capitalization and periods, which are constraints in computer operations. Abbreviated terms can be used when meanings are well established and when significant gains in convenience can be demonstrated. Examples are: *ACTH* for *adrenocorticotropic hormone; PETN* for *pentaerythritol tetranitrate; VTOL aircraft* for *vertical take off and landing aircraft*. Abbreviated and unabbreviated forms of a given term should be treated as synonyms and cross referenced accordingly. (See Rule C-2c.) Well established acronyms are acceptable as descriptors; for example, *shoran, radar, maser*.

T-10
Specialized Vocabularies

Effective indexing and retrieval of information in certain specialized subject fields will require descriptor vocabularies that differ in some ways from the natural language approach of the thesaurus as a whole as in the following examples.

a. Chemistry. To avoid proliferation of terms in the field of chemistry, the names of specific chemical compounds as descriptors should be restricted. Instead, a vocabulary of descriptors representing generic compounds classes, functional groups, and structural features should be devised. This will permit indexing and searching by coordinating appropriate descriptors to denote specific compounds as well as classes of compounds.

Names of specific compounds that occur frequently in the literature may be entered as descriptors; for example, *sulfuric acid, carbon tetrachloride, morphine, progesterone*.

b. Alloys. Descriptors should be established for certain generic alloy families; for example, *aluminum copper alloys, molybdenum steels, zinc alloys*. This will permit indexing and retrieval on a somewhat general level, but will prevent proliferation of descriptors to represent specific alloy systems.

c. Biological nomenclature. Where possible, consistent use should be made of established nomenclature systems for describing plants and animals. Where departures are necessary, cross references should be provided to maintain continuity.

T-11
Multiword Descriptors

A descriptor represents a concept. In general, a descriptor should reflect the terminology found in the literature regardless of the number of words needed to express the concept. However, many candidate descriptors will represent, or appear to represent, concepts that are combinations of two or more specific descriptors or potential descriptors. In these instances, a determination must be made of the most effective way in which to incorporate the candidate descriptor, that is, by adding the specific multiword term to the thesaurus or by prescribing a combination of two or more existing descriptors.

Specific multiword descriptors often facilitate retrieval of specific information, but may add to the cost of indexing by increasing substantially the number of descriptors in the index. On the other hand, proper use of individual descriptors in indexing for later combination upon retrieval will serve to control the size of the vocabulary and to promote consistency in the use of terminology. Decisions on the formation of specific descriptors require consideration of the following factors. If reasonable doubt remains, a specific multiword descriptor should be established because, if it eventually proves to be of little utility, it can easily be reduced to a combination of individual descriptors. The converse is not easily accomplished.

a. A specific multiword descriptor should be established when suitable more general descriptors are not available in the vocabulary. To provide adequate representation of the specific concept, a combination of general descriptors must include at least one descriptor that is a member of the same hierarchical class as the specific concept. Observation of this principle will promote more consistent and complete retrieval, whereas the use of a combination in which neither descriptor bears a generic relationship to the specific concept may lessen retrieval efficiency.

b. A specific, multiword descriptor should be established when the specific concept is encountered so frequently that the ability to index and search directly would be both expeditious and economical or when one or both of the more general descriptors is so often used in indexing as to make searches awkward or inaccurate.

c. Two or more individual descriptors should be used instead of establishing a specific multiword descriptor when the specific concept is a member of the same generic class (See Rule C-4) as each of the more general descriptors; for example, *arc oxygen cutting* is a member of the classes *arc cutting* and *oxygen cutting*, so may be represented by those descriptors. When individual descriptors are employed in preference to a specific descriptor, the appropriate cross reference should be added to the Thesaurus. (See Rules C-2-d and C-3.)

Cross References

C-1
Cross References

Relationships among terms will be shown by cross references, which will aid users in selecting descriptors from the thesaurus. Types of cross references and their symbols that will be used as required are:

Cross References	Symbols
USE	USE
USED FOR	UF
BROADER TERM	BT
NARROWER TERM	NT
RELATED TERM	RT

These are described in the following rules.

C-2
Use

The USE reference is intended to lead users of the thesaurus to appropriate descriptors and should be employed to refer from a term that is not an authorized descriptor to the term which has been chosen as the descriptor, as follows:

a. to indicate a preferred synonym; for example, *lysozyme* USE *muramidase; secondary batteries* USE *storage batteries;*

b. to refer from a specific term to a more general term which has been selected to represent (that is, subsume) the specific concept; for example, *plant waxes* USE *waxes; sand blasting* USE *abrasive blasting;*

c. to indicate a preference between spelling variations, or to expand or explain abbreviations; for example, *pi mesons* USE *pions; inflammability* USE *flammability; pentaerythritol tetranitrate* USE *PETN; IFF* USE *identification systems;*

d. to prescribe the use of two or more descriptors to express a concept; for example, *ferromagnetic films* USE *ferromagnetic materials* and *films; antitank rockets* USE *antitank ammunition* and *rockets; optical illusions* USE *illusions* and *vision;*

e. To express concepts that can be considered synonyms for purposes of indexing and retrieval; for example, *heredity* USE *genetics; semantemes* USE *semantics;*

f. to bring together different viewpoints of a conceptual continuum; for example, *fluidity* USE *viscosity; smoothness* USE *roughness; instability* USE *stability*.

g. to explain variations in word order; for example, *tables (mathematics)* USE *mathematical tables; propellers (aerial)* USE *aerial propellers; propellers (marine)* USE *marine propellers;*

h. to reflect current terminology; for example, *electrical condensers* USE *capacitors;*

i. to eliminate jargon; for example, *whirly bird* USE *helicopters.*

C-3
Used For

The USED FOR reference (UF) is the mandatory reciprocal of the USE reference and accompanies the descriptor to which the USE reference refers. Accordingly, the USE references in two of the examples given in Rule C-2b and C-2c would generate the following USED FOR references:

abrasive blasting
UF sand blasting

pions
UF pi mesons

When a USE reference has prescribed two or more descriptors to represent a concept (See Rule C-2d), a unique symbol such as the dagger sign (†) should be placed in front of the unauthorized term in the USED FOR reference; for example, *ferromagnetic films* USE *ferromagnetic materials* and *films;*

ferromagnetic materials
UF †ferromagnetic films

films
UF †ferromagnetic films

C-4
Broader Terms

The BROADER TERM reference (BT) is employed to refer from a term representing a member of a class (or classes) of concepts to any term(s) in the thesaurus representing that class or classes; for example, *steels* BT *iron alloys*. For each BROADER TERM reference there must also be provided a corresponding NARROWER TERM reference. (See Rule C-5.) The part-whole relationship is usually not a broader-narrower relationship; for example, *gear teeth* BT *gears* is incorrect. However, in certain specific areas, part-whole generics can be usefully employed. These areas are anatomy and geographic locations. Also specifically excluded from the broader-narrower term category are relationships based on the possible applications or uses of an entity; for example, *platinum* is not considered to be a member of the generic family *catalysts* because, although it is sometimes used as a catalyst, it has too many other applications to list all as broader terms. *Platinum* is, however, always a member of the class metals, so that the reference *platinum* BT *metals* should be entered.

Wherever a descriptor for which there are narrower terms in the vocabulary appears in the thesaurus display as either a narrower term or a related term, it should be preceded by an unambiguous symbol (such as the hyphen) to indicate that it is not the most specific concept of its class. The placement of such terms in the thesaurus should be such that the term is left justified according to its first alphabetical character (so that the alphabetical portion of the entry lines up with the terms above and below it in the display). (See also Rules C-5, C-6, and C-8.) For example in the thesaurus display:

impedance

NT acoustic impedance
capacitive reactance
characteristic impedance
– electrical impedance
– electrical resistance
inductive reactance
input impedance
– reactance
transfer impedance
RT bandwidth
conductivity
– damping
dead time
– dynamic response
hold-up
– resistivity
transient response,

the hyphen designator shows that, for the terms so designated, there are more specific terms available in the vocabulary.

C-5
Narrower Terms

The NARROWER TERM reference (NT) is the reciprocal of the BROADER TERM reference (See Rule C-4) and is employed to refer from a term symbolizing a concept class to all terms symbolizing concepts that are members of that class; for example, *iron alloys* NT *gray iron, mottled iron, steels*. For each NARROWER TERM reference, there must be provided a corresponding BROADER TERM reference.

C-6
Hierarchy

BROADER TERM references and NARROWER TERM references are hierarchical references. If there exist more than two levels in such hierarchies, the cross references for all levels should be completed for each term. This is done to enable the thesaurus user to ascertain the appropriate level of specificity in a family of generically related concepts and to promote editorial consistency during thesaurus revision, or in cases where portions of the thesaurus are extracted as specialized indexing vocabularies.

In a few instances, terms will be so broad in meaning that their utility as indexing terms will be doubtful, yet they must be retained for use in disciplines of peripheral interest or merely as a guide to more specific terminology. Under these circumstances, list under the very broad descriptor the terms to which it is desirable to refer the thesaurus user omitting cross reference designators. Append to the broad descriptor the scope note *Use of a more specific term is recommended — consult the terms listed below*. For example, the term *materials* is of little use in indexing documents that deal with materials in any but the most general way, but in a vocabulary in which many specific materials types are represented by indexing terms, the term is a useful point at which to display certain more specific terms or related terms for further study without carrying a useless BROADER TERM reference to *materials* on each of many specific terms. No reciprocal cross references should be made from listed specific descriptors to the broad descriptor, although such records should be maintained for housekeeping purposes. (See Rule C-9.)

C-7
Hierarchy Overlap

Terms may be members of more than one hierarchy. (See Rules C-4 and C-5.) For example, consider the entries *avalanche diodes* BT *diodes* and *semiconductor devices; diodes* NT *avalanche diodes*. The term *avalanche diodes* represents a concept that is properly a member of the two different classes of concepts represented by the terms *diodes* and *semiconductor devices*.

C-8
Related Terms

The RELATED TERM references (RT) is employed as a guide from a given descriptor to other descriptors that are closely related conceptually, but not hierarchically. (See Rules C-4 to C-7.) In general, any two descriptors are cross referenced RT if it is believed that the user, when examining one descriptor, might want to be reminded of the existence of the other.

RELATED TERM references may be used to identify:

a. descriptors that are closely related in meaning or concept including those in different hierarchical structures.

b. descriptors that are near synonyms.

c. descriptors that have viewpoint interrelationships, such as a relationship based on usage; for example, *alcohols* RT *solvents*, RT *antifreezes*.

d. descriptors representing concepts bearing a part-whole relationship to each other.

C-9
Reciprocal Entries

Reciprocal entries are required in every instance of cross-referencing except as noted in Rule C-6. The three pairs of reciprocal cross references are:

USE	USED FOR
BROADER TERM	NARROWER TERM
RELATED TERM	RELATED TERM

E-7 and E-8

Alphabetization

A-1

Alphabetize descriptors letter-by-letter, according to the following rules:

(1) Ignore all spaces between words.

(2) Ignore all characters other than left parenthesis, numerals, and letters.

(3) File according to the sequence:

  (a) left parenthesis

  (b) numerals in usual order

  (c) letters in usual order

A representative sequence of terms filed according to the above rules is:

mercury (metal)
mercury (planet)
mercury amalgams
mercury arc rectifiers
mercury lamps
metal finishing
metallurgy
metals
metal working.

NOTE: *Metal working* is sometimes spelled as one word, *metalworking*. In letter-by-letter alphabetization, the sequential position of *metalworking* is unaffected by the spelling selected for the authorized descriptor. Similarly, the sequential position of *metal-working* is unaffected by the use of a hyphen.

STANDARD TITLE PAGE FOR TECHNICAL REPORTS

1. Report No. CPS-69-005-2

2. Govt. Accession No.

3. Recipient's Catalog No.

4. Title and Subtitle
TECHNICAL, INTELLIGENCE, AND PROJECT INFORMATION SYSTEM FOR THE ENVIRONMENTAL HEALTH SERVICE VOLUME II. EHS INFORMATION NETWORK ANALYSIS

5. Report Date June 29, 1970

6. Performing Organization Code

7. Author(s) Ralph L. Darby, Robert S. Kohn, Thomas E. Carroll, W. David Penniman, and David L. Morrison

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Battelle Memorial Institute
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

10. Project/Task/Work Unit No.

11. Contract/Grant No. CPS-69-005

12. Sponsoring Agency Name and Address
U. S. Department of Health, Education, and Welfare
Environmental Health Service

13. Type of Report & Period Covered Final

14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstracts

This study for the Environmental Health Service is an investigation of the problems being faced in protecting man's environment from threats created by man. This study included the following major efforts: (1) research and development planning in the perspective of man in his total environment, (2) information network analysis, and (3) model case studies. This volume of the report concerns itself with Information Network Analysis. An investigation was made of the existing EHS information resources including the monitoring and surveillance activities. A survey was conducted of the documentation systems and libraries in order to determine their operational characteristics as related to an information network.

17. Key Words and Document Analysis. (a). Descriptors

Health
Environmental Engineering
Information Systems
Documentation
Libraries
Monitors
Surveillance
Information retrieval
Surveys

Thesauri
Computer Programs
Data Processing

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group 06/F; 05/B

18. Distribution Statement
Releasable to the public

19. Security Class (This Report) UNCLASSIFIED

20. Security Class. (This Page) UNCLASSIFIED

21. No. of Pages 160

22. Price

FORM NBS-867(1-70)